THE UNIVERSITY OF ALBERTA

ALBERTA GRAZING ASSOCIATIONS:
A STUDY OF PUBLIC RESOURCE UTILIZATION

by

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A THESIS

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Abstract

This study focused on an Alberta government policy which allows farmers and ranchers throughout the province to use public land for summer grazing. The study subjects were Alberta Grazing Associations(a type of community pasture) since they utilize a large share of public acreage and serve over 1,400 members.

Three objectives were set: 1--to describe pasture patrons in economic and physical terms, 2--to provide estimates of the importance of Grazing Association acreage for a patron and for society, and 3-- to detail any current or potential areas of conflict arising from the use of public land for grazing.

Regional data were collected in summer 1978 through interviews conducted by the author. Results of the survey indicated that members depend highly on this land since few or no alternative summer pastures are available. Large herd reductions were expected without these public pastures. A production function approach was used in an attempt to measure pasture value for a patron, but failed to do so conclusively. A benefit-cost analysis was then used to show the incidence of all current use patterns found on these pastures.

Results indicated that a large portion of net benefits were primarily incident upon Grazing Associations. Grazing

may not be the best use pattern to follow and alternative uses on these lands, such as recreation, may require attention if social needs are to be better served. In this context, the current pastureland policy of single-use orientation may be deficient. By addressing other use possibilities, future potential conflicts may be avoided, or at least minimized, and social net benefits may be enhanced.

Acknowledgements

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My appreciation goes out to my parents and family for their patience with me, and to the Wilsons for for their continued support. I especially thank Barbara for her devotion and having confidence in me.

...I consider that a man's brain originally is like a little empty attic, and you have to stock it with such furniture as you choose... the skilled workman... will have nothing but the tools that help him in doing his work... It is a mistake to think that that little room has elastic walls...

Sherlock Holmes in, "The Science of Deduction", A. Conan Doyle,A Study in Scarlet,1929.

...I consider that [illegible] like a

a little empty attic, and [illegible]

such furniture as you choose... the skillful

workman... will have nothing but the tools [illegible]

him in doing his work... It is a mistake to [illegible]

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Sherlock Holmes, "The [illegible] of Deduction", [illegible]

Doyle, A Study in Scarlet, [illegible].

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I. INTRODUCTION TO THE PROBLEM

The use of public land by community pasture Grazing Associations for summer pasture is examined in response to several contemporary concerns. Public lands are capable of several uses, singly or jointly, but are presently used primarily for livestock purposes. Little published work has examined the economic effects of public pasture land utilization on the users, the types of enterprises that use public land, or the economic contribution of public grazing to society. In other words, efficiency criteria have rarely been applied to examine the use of this natural resource, and little economic assessment of policy has taken place.

Groups other than grazing interests are calling attention to potential alternative uses of public grazing land. Some of these alternative uses will be compatible with cattle grazing, others will not. Increased net social benefits from a use mix of public land requires delineation of use benefits and costs. Use combinations need to be quantified so that net social benefits are increased. As group concerns regarding this resource and how it is used become more evident in society, policy-makers will need more supporting evidence to address these problems. Clear evidence of the tradeoffs involved among uses will be needed.

This study attempts to identify net user benefits, to identify net benefits to Albertans, to describe possible problem areas(ie.,conflicts among different uses), and to indicate policy directions for the future.

A. Statement of the Problem

During the recent history of Western Canada a program has evolved to help livestock producers graze their surplus animals on public lands of marginal agricultural quality. Development of similar programs throughout the Prairies and in other provinces has shown this type of program to be popular. Utilization of public lands for grazing purposes by cattle ranchers in southern Alberta occurred as early as 1881. Community pastures *per se* had their start in 1930, and continued with steadily increasing acreage. Currently, use of public land for grazing purposes is either on a group or individual basis. Community pastures, that is, those used on a group basis, include two main types in Alberta:reserves and associations.

Community pastures presently account for about 1,300,000 acres(526,500 hectares) of public land, of which 900,000 acres(364,500 hectares) are utilized by associations. The public land used by associations is located from southern Alberta to northern Alberta, serving about 65,000 cattle each year. Many associations have been operational for approximately 40 years and patrons feel strongly tied to the use of this land. Several questions

regarding this use of public land illustrate the context of the problem.

What would be the result if public acreage was not available to farmers and ranchers? Would there simply be a movement to shift cattle onto privately owned marginal land or would herd populations have to be reduced? How dependent are the users on this land? Initially,the grazing program was developed to help the small producer to diversify, stabilize his income, and increase efficiency in the industry.

Alberta's natural endowment of quantities of water, good soils, and sufficient rangeland for cattle grazing, stimulates production of significant numbers of beef cattle and calves. Alberta is acknowledged to be the largest producer of beef cattle in Canada (38% of beef production) and is a continual net exporter of beef. As economic growth occurs in Canada, demands for desired products will grow also. In 1977, population estimates for Alberta and Canada were 1.92 million and 23.4 million, respectively. Projections for 2000 range from 31 to 43 million people in Canada. [1]

In 1966, estimates for per capita beef consumption were 84 lbs., while current estimates reached 94.7 lbs.(1974) and

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[1]Hu Harries & Associates Ltd.,<u>The Future Land Needs for Alberta Agriculture</u>,Technical Report No.5(Edmonton:Alberta Land Use Forum,1974);N.F.Pearson,<u>The Effect of Urbanization on Agricultural Land</u>,Publication No.65(Ontario:University of Guelph,Center for Resources Development,1972).

110 lbs. (1976)[2]. In the future it is expected that population and per capita consumption will increase, both nationally and internationally. Provision of higher beef supplies or substitution of other meat for for beef are required in this case, otherwise beef shortfalls may result.

Several authors have suggested that in order to deal with these expected deficits, available acreage (through private or public development) must be increased or the carrying capacity of current acreage must be improved. Development of private land for use appears to be a profit motivated practice and is supported by several studies.[3] Since marginal public land does not follow this pattern of change, the supply of public grazing land is relatively constant, with minor increases over time(Table 2.2).

As Canadian and world populations continue to grow, so will the demand for animal products such as beef. Coupled with this growth are expected decreases in farmland. Pasture acreages will dwindle as pressures for land are exerted by urban purchases, more recreation areas, wildlife habitats, highways, and other alternative uses. [4] Perhaps land zoning

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[2] Ibid.

[3] In separate studies, J. Wiens and M. Sorboe showed how marginal land was taken out of forage production and put into higher income earning crop production. J.Wiens,"Economics of Forage Production and Use on Grain-Cattle Farms",Canadian Farm Economics,Vol.9,No.4(1974);M. Sorboe,"An Economic Analysis of Grain-Beef Cattle Farms in the Lloydminster-Battleford Area of Saskatchewan",Canadian Farm Economics,Vol.11,No.2(1974).

[4] These uses could be considered as basically irretrievable but not irreversible since social concerns may prevent the land these uses dominate from re-entering the land market.

or freezes may inhibit purchases of prime farmland for such uses, but the demand would simply shift to the next alternative --ie., marginal land. Now competing land uses have more public support and may force public grazing to be reduced. Approximately 65,000(.01%) of the total Alberta cattle population owned by over 1,400 Grazing Association patrons annually graze on public land.

The most notable presence of alternative land uses are evident near surrounding urban areas. A provincial land value study noted this concern in 1976.

> The net result of this is tremendous economic pressure on urban periphery farmers to sell out and cash in on the inflated land value in alternative uses. Clearly outlined policies in this area may be needed to assist the transformation of this land to the best alternative use(s), for instance to aid the agricultural industry in the retention of land for productive purposes. Is this periphery land more valuable for food it produces or for the living space it allows for expanding population?[5]

In this study, Grazing Associations are examined with regard to several contemporary concerns. Provincial monies are currently being spent to develop more public pastures in various parts of the province. Concerns over the use of public land for grazing have been expressed by various

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[5]R. Prather, et al., 1976 Agricultural Real Estate Values in Alberta (Edmonton: Resource Economics Branch, Alberta Agriculture, 1977).

parties. The central problem of this study is to examine the grazing use of public land with respect to alternative uses. Although historical use patterns favor grazing, other possibile uses may now require attention. What array of uses are currently evident on these lands? Who benefits and who bears the costs? Have initial policy objectives been met? What benefits and costs accrue to society? These concerns are addressed in this study.

B. Scope and Objectives

Associations and reserves differ in that grazing associations manage themselves and reserves are managed by the government. However, both corporate forms are classified as community pastures since their operations involve use of a public property. Associations exist in greater numbers than reserves; further, they are more popular than reserves. The amount of land used and cattle accommodated by associations is greater than for reserves.

Given the above, three main objectives were established for the study:

1. An association user profile was created to describe the types of farms using pastures. Profiles were specified in terms of economic and physical dimensions. A secondary objective was to estimate how dependent users were on public land to maintain an economic unit. The estimate included an assessment of any nearby alternative grazing lands.

2. An estimate of the amount of beef resulting from the use of this land was made. Approaches generally use linear programming, simulation, or budgeting methods to estimate a marginal value product for public grazing land. In this study two approaches were used to get these values. Linear regression was used to estimate production functions, marginal values, and returns to scale. Budgeting was used to estimate net benefits, excluding the linkage effects, to individuals and to society. A benefit-cost framework was employed for the analysis.
3. The final objective was to examine any land-use conflicts or problems perceived by association members. Conflicts in land use may arise when alternative uses like recreation, hunting or wilderness retention are desired in place of grazing.

Discussion of background information to the problem, its setting, and regional descriptions are given in Chapter II. The third chapter deals with relevant literature and the theoretical basis. In Chapter IV, survey results are presented and discussed. The next two chapters present pasture value estimates. In the last chapter a study summary, the conclusions and policy implications are given.

II. BACKGROUND DESCRIPTION TO THE PROBLEM

In this chapter a short discussion will address two main areas of background information. The first section will review former Dominion and Alberta public land policies concerning grazing. Much of today's policy has its foundations in these previous government policies. The next section describes the regional economic and physical characteristics related to association activities.

A. Historical Land Policy

Dominion Lands Policy to 1930

Western Canada's early development and settlement began with the fur trade. As early as 1670, the West was being explored by the Hudson's Bay Company. Rights to Western Canada, then known as Rupert's Land, were granted to the Hudson's Bay Company under a British charter.

Although there was competition by the North West Company, the Hudson's Bay Company maintained strong control over Rupert's Land, allowing the first settlement in 1811 at the Red River. In 1846 the Hudson's Bay Company signed a treaty with the Americans to establish the 49th parallel and secure the British territory. As well as the local disruptions, the Hudson's Bay Company encountered a challenge from the

Canadian government on what boundaries Canada should have.

In 1856, the Canadian Ministry was alarmed about national land rights:

> question of the jurisdication and title claimed by the Hudson's Bay Company is to Canada of paramount importance.[6]

Proceedings took place in England to settle the dispute of rights and after ten years of negotiations, involving England, Canada, and the Hudson's Bay Company ,Rupert's Land was transferred to Canada for a price.

In 1857, Captain John Palliser and others were sent by Britain to survey Rupert's Land. Canada later modelled its grid system after the U.S. grid system . Townships in this system contain 36 sections in an area of 6 square miles. Upon settlement of claims with the Hudson's Bay Company in 1870, the Canadian government divided its new lands as follows:

1. In each township, 1,280 acres were set aside for a school fund ,(sections 11 and 29)
2. In Alberta, 2 sections of every fifth township and 1.75 sections of all other townships south of the North Saskatchewan River went to the Hudson's Bay Company as partial payment. In total, the Hudson's Bay Company ended up with 1/20 of the arable land, full trading rights, and 300,000 British pounds.

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[6]G. Bryce,The Remarkable History of the Hudson's Bay Company(Toronto:Briggs Co.,1900).

Final settlements in 1924 realized 6,639,059 acres for the Hudson's Bay Company in Alberta.[7]

3. Odd-numbered sections (not school grants) were reserved as railway grants. Over 13 million acres went to the railways in Alberta alone.
4. Even-numbered sections were made available to new homesteaders for farming (Figure 2.1).

The settlement later was acknowledged as being impractical since it resulted in a checkerboarding of the land, thereby creating many disjointed sections which prohibited farm purchases of adjoining arable lands. The Dominion government's responsibilities for the land included settling the new area, encouraging new railway growth, and carrying out its agreement with the Hudson's Bay Company. Homesteading in the West was encouraged by passage in 1872 of the First Dominion Lands Act. This act clearly set out the philosophy for establishing 160 acre farms as economic units. In hindsight, this was criticized as the reason for the downfall of many farms. Acreage of this size simply proved to be uneconomical.

By paying a $10.00 homestead entry fee, any male British subject could lay claim to 160 acres of free land. It became his if he resided on it for 6 months each year and broke 15 to 25 acres in that period. Successive purchases could be made in a similar fashion

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[7]C. Martin, Dominion Lands Policy (Toronto: MacMillan and Stewart, 1973).

Figure 2.1. Land Disposition in Alberta in 1870

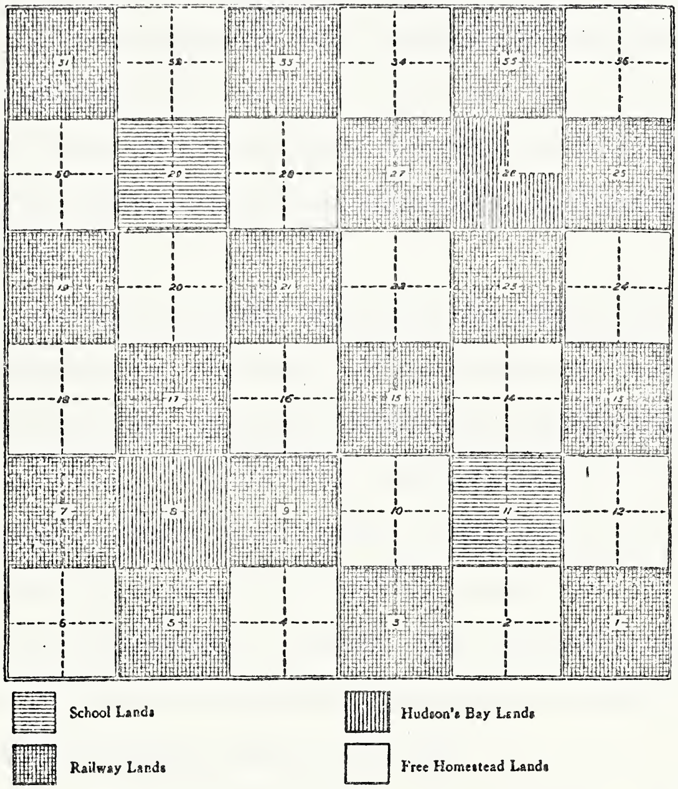

Fig. 1)– Plan of Township showing: (a) School Lands (Sections 11 and 29), (b) Hudson's Bay lands (Sections 8 and three-quarters of 26; the whole of 26 in every fifth township), (c) Free Homestead lands (even-numbered sections, except 8 and 26), (d) Railway lands (odd-numbered sections reserved for selection as railway land grants). Each section is bounded on three sides by road allowance (66 feet).

Source: C. Martin, Dominion Lands Policy, (Toronto: Macmillan and Stewart, 1973), p. 18.

at a cost of about $3.00 per acre.

Even after the provinces of Alberta and Saskatchewan joined in 1905, the Federal government continued to use this act as a method to help settle the West. By 1929, the Federal government was satisfied that its purposes had been achieved

> ...the railroads have been built and the lands settled. [8]

After 1908, the railroads selected land from the grants and the balance was made available to homesteaders for farming.

While the Lands Act did help promote primary settlement in the West, it was shown to have several deficiencies. Creation of 160 acre farms did not prove to be viable for survival. Many farmers in the Depression lost their farms through the Tax Recovery Act because of unpaid tax claims, leases of some lands were in various stages of decay, and there was an uneven distribution of population throughout Alberta.

Dominion Grazing Policy to 1930

Federal grazing policies were initiated as early as 1872 under the original Lands Act. Changes came in 1876-- leases were subject to cancellation with two years notice if needed for agricultural settlement-- and in 1881-- leases were set at 100,000 acres maximum at 1 cent rent per acre for a maximum of 21 years. Stocking

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[8] Ibid., p. xxi.

rates were set unrealistically high, at 10 acres per animal. New regulations in 1887 provided open leases for a maximum of 21 years subject to immediate homestead entry if required for homesteading. Until 1905 similar terms prevailed for grazing leases with uncertainty of the homestead clause being a major problem for farmers and ranchers.

By 1912, a committee was set up to study the problem, and later made recommendations that are the foundation of today's grazing policies. The two year cancellation policy was discontinued , leases were created for ten year periods with prior renewal rights, stocking rates were lowered to 30 acres per animal, and mixed farmers were to be given priority. All of this was tabled by an Order-In-Council in 1914. Pricing of the leases was done on a flat fee basis and taxes were paid separately. Although the terms appeared to be uncertain, lease acreage between 1905 and 1930 increased from 1,551,372 acres to 3,220,161 acres.[9]

Settlement of the West and the joining of the Prairie provinces in 1905 indicated that the Federal government accomplished much of what it wanted to do. In order to unite the country and to counteract American threats, the railroads were built causing much agricultural settlement to occur near them. In 1930, satisfied that initial objectives had been met, the

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[9]Ibid.

Federal government transferred natural resource ownership to the provinces.

Alberta Land Policy Since 1930

Vested with new authority, the Alberta government passed the Provincial Lands Act in 1930 to provide administration of the public and school lands. Until 1939, no real changes were made in the method previously used by the Federal government to administer land policy. However, because of the Depression's effects on farms and their income-earning capacity, the Homestead Lease policy was enacted in 1939. Objectives of this policy were to create long-term grazing leases, encourage agricultural settlement, and protect forestry areas. Even though it overcame several serious difficulties, there still were some major barriers to users.

Due to the limited resources available to a lessee, many sons and daughters had to rely on their parents for provide financial support. Also, once a lease was granted to a lessee, government guidance could not be offered. Farm failures could have been reduced if financial and technical assistance was offered but the government thought this would infringe on the rights and actions of a lessee. However, in comparison to the previous policy, the Homestead Lease policy did help farmers in a rather difficult time.

In order that lands could be dealt with more

easily, all tax recovery lands were transferred to the Department of Lands and Forests from the Department of Municipal Affairs in the 1930s. In 1937, a Tax Recovery Act was passed to allow this department to administrate fees and taxes on public lands.

Previously, all fees had been based on a flat fee charge . Due to the fact that forage values were underpriced, a new formula was designed in 1939 to account for several major factors in grazing. The new formula was based on previous prices and a carrying capacity of the land(carrying capacity is the number of acres needed to support a mature cow with calf for a month). A committee comprised of members of the Western Stock Growers Association and a representative from the Department of Lands and Forests developed the formula. It tries to approximate the marginal value of the forage more closely, but still lags prices by about six months.

Price formula: $1/10 \times (250 \times P)/G.C.$ = rental and taxes per acre

where:

1. 250 is the average gain in pounds of beef on grass,
2. 1/10 is the royalty(tax and rental) charge ($),
3. P is an average price for previous July to December cattle, excepting feeder calves, and
4. G.C. is the grazing capacity in acres per cow. [10]

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[10] V.A. Wood, "Alberta's Public Land Policy, Past and Present," Journal of Farm Economics, Vol.33No.4(November 1951).

This new method of calculating charges was instituted in 1945 for all grazing leases and annual grazing permits. Stocking rates were set by study recommendations at about 30 acres per cow. Lease lengths were set at 20 years with renewals and the prices could fluctuate as cattle prices did.

Essentially the same formula is used today for rentals. In fact, the only major change is that royalty rates are now set each year by the provincial government. Royalty rates are similar to taxes collected under the old system.

Land Administration

To help achieve growth objectives and better land administration ,in 1948, the Alberta government implemented a land classification system which is still used. Two major zones were created-habitable and non-habitable. These were further divided into three areas: Green, Yellow, and White areas. Under the Land Settlement policy, the division allowed for better administration and development in these areas.

The Green area is a non settled area where such uses as forestry, fishing, hunting, recreation, and some grazing occur. Land in this area is managed by the Alberta Forest Service.

In the White area, land is settled and much of it is privately owned although there are significant amounts of public land also. Recreation, wildlife

habitats, and forestry uses are also evident in this area.

In the Yellow area, land is still available for homestead settlement and is therefore transitory in use.

Geographically , public lands are in all three color areas and differ in departmental management. All land labelled Special Areas is under the control of the Department of Municipal Affairs (A special area is a developmental area with special problems and is administered by the Special Areas Board).The rest of the public land is under the direction of two arms of Alberta Energy and Natural Resources. The Public Lands Division manages most of the grazing land while the Forest Service operates a small portion of forest lands for grazing.

Lands that are developed for public grazing are usually located on marginally productive land that cannot grow a cereal crop. Regulations of the Public Lands Act state this criteria as a guideline for new pasture development.

Grazing Lands Policy in Alberta

Before the 1930s, little organized community grazing on public lands was in evidence.[11] Grazing then existed mainly in Forest Reserve Areas. Illegal grazing probably was taking place prior to 1930, and during the Depression when farmers had problems of economic

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[11]Information in this section is based on correspondence with the Department of Energy and Natural Resources.

survival without incurring additional cash outflows to pay for grazing.

The first community pasture was created to deal with uncontrolled grazing on public lands. In 1935, the first grazing reserve was started in Township 1, range 19, west of the 4th meridian. Its establishment was prompted by farmer and government recommendations. A pasture manager was hired to oversee it and permits were issued for livestock. As the Depression waned, demand for more public grazing land grew.

As a consequence of the Depression, the Federal government responded with the P.F.R.A. (Prairie Farm Rehabilition Act) in 1935. Objectives of this act were to improve land productivity, develop water resources, instill more efficient use of the land, and to disseminate information on soil and cropping practices. Community pastures were also part of this agreement and in Saskatchewan and Manitoba many P.F.R.A. pastures were created . Alberta did not participate in the agreement because one of the conditions to finance a pasture was that all title to lands included in the pasture be turned over to the Federal government. Under public pressure in light of the refusal, the Alberta government started its own pastures.

Growth of the popularity of public pastures is shown in Table 2.1. From 1945 to 1975, association numbers increased from 6 pastures to 84. Grazing

Table 2.1. Number of Grazing Reserves and Grazing Association Leases

Fiscal Year Ending March 31	Number of Grazing Reserves Operated By Lands Division	Number of Grazing Reserves Operated By Associations On A Permit Basis Or Allotment Basis	Number of Community Pastures Held Under Grazing Lease
1945	3	4	6
1950	2	1	18
1955	2	2	25
1960	4	2	48
1965	10	13	72
1970	15	16	85
1975	18	21	84

Source: Correspondence from Department of Energy and Natural Resources.

reserves proved less popular; from 1945 to 1975, numbers grew to 18 from 3. Until the late 1950s, most community pastures were developed in the south and central areas of the province because of low capital costs. Later, in the northern areas of Alberta, pasture demand increased and land was assembled for use.

Under authority of the Land and Forestry Utilization Act of 1956, the province started to purchase land for grazing reserves. Criteria used as a basis for purchases were:

1. Enough land had to be accessible for a community pasture;
2. The owners had to agree to sell the land;
3. There had to be a demand for the land;
4. The area had to be a problem area where government services were lacking;and
5. The pasture had to support a minimum size of 1300 head carrying capacity.

Later,the Federal government, under the A.R.D.A. agreement (Agricultural and Rural Development Act, 1962) and subsequent renewals of A.R.D.A. II (1966) and A.R.D.A. III(1971), initiated several range improvement programs. Other forms of assistance were evident in 1951, 1966, 1969, and 1973.

Development costs were at first paid by the province since it denied the formation of P.F.R.A. pastures in Alberta. Later, through such programs as

rangeland improvement and land assembly, the Federal government assisted in the cost sharing.

There are approximately 10 million acres available for public grazing lands in Alberta. Of this amount, community pastures use 1,300,000 acres in two main forms, grazing reserves and grazing associations (and co-ops). Associations make up 900,000 acres and reserves 400,000 acres of the total acreage (Table 2.2). Both of these types are managed by authority of the Public Lands Act, and there are both individual and community pasture leases managed by the Special Areas Board and Forest Services respectively. Provision for use in the Special Areas is given by the Special Areas Act.

Methods of Contract

Agreements to use public land differ in tenure, method of payment, or arrangement. Either individuals or corporations may undertake an agreement with the government by way of a lease, head tax permit, permit, or license.

Grazing reserves are created by the province under section 111 of the Public Lands act, and they are managed by the government. This section states:

> When the Minister(of Energy and Natural Resources) is satisfied that the interests of the farmers or ranchers in any area of the Province demand it, he may establish, maintain,

Table 2.2. Area of Public Land Grazed

Type of Grazing Disposition	Acres (Approx.)	Percentage of Total Area
Grazing Leases to individuals, partnerships or companies	4.100.000	41.0
Grazing leases to associations operated as community pastures	900,000	9.0
Grazing reserves	400,000	4.0
Grazing leases - Special Areas	2,900,000	29.0
Grazing permits	800,000	8.0
Forest grazing allotments	900,000	9.0
Total Public Grazing Land	10,000,000	100.0%

Source: Correspondence from Department of Energy and Natural Resources.

Table 2.3. Land Purchased Under the Land Assembly Program for Grazing Reserves

Year	No. of Parcels	Acreage	Total Cost
1972	59	8,984.0	$145,374.51
1973	8	1,171.2	31,307.61
1974	6	865.9	38,275.00
1975	11	1,716.0	106,000.00

Source: Correspondence from Department of Energy and Natural Resources.

and operate a community grazing reserve.[12]

Grazing reserves offer patrons hired government supervision of their livestock in the summer months. Reserves are developed and operated by the Public Lands Division of Energy and Natural Resources. When people in an area decide that a pasture is needed, they notify this division. After an inspection of the area related to the need for and the feasibility of a pasture, a decision is made on the application. Once approved, and after all necessary improvements are made, the new patrons organize an association and elect an executive. This body acts together with the government as an advisory group on any problems or policies. Cattle are accepted into the pasture under the Head Tax Grazing Permit regulations. These regulations set the terms of payment, priority of entry, and conditions of grazing livestock.

Grazing associations may secure leases for up to 20 years for memberships of five or more patrons. This type of community pasture is a corporate body, subject to provisions under the Societies Act or the Co-operatives Associations Act. Currently, there are both associations and co-ops in this group (there are 77 associations and 7 co-ops in a corporate form). By being a legal entity, the size of pasture acreage is not limited as it is for individuals. Policing of livestock, decisions on new

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[12]Alberta, Revised Statutes, c.297, s.111.

memberships, improvements, and management of the range is done by the association or co-op. Rent is collected by the same division, and taxes are paid separately to municipal governments. If any local applicant thinks he is unjustly being denied membership, the Minister has the authority to investigate. If too many cattle are alloted per patron, the Minister can reduce the head allotment to 20 animals per member.

Individuals may lease public land for grazing as well. Tenure is for 5, 10, or 20 year terms and applicants must be at least 18 years old and Canadian citizens. One person may hold land for up to 600 head of cattle in a 12 month period. Again, taxes are paid locally, and fees are priced by the formula. Periodic government inspections are made, regional stocking rates are set , and prior renewal rights exist. Problems of insecure tenure may be sufficient to deter investments, but three government programs offer assistance for land improvement.

Permits are issued annually to individuals and are subject to similar conditions as leases. A major difference is in the length of tenure, which creates insecurity. Rental rates are set by the formula.

Head tax permits are also issued annually for grazing cattle, horses, and sheep on undeveloped areas. A pricing difference is that a per head per month charge is used. Little government supervision is done because

of the difficulty in getting to the areas.

Different arrangements are available to lease public land for grazing and vary in pricing, tenure, and the conditions set.

B. Study Regions

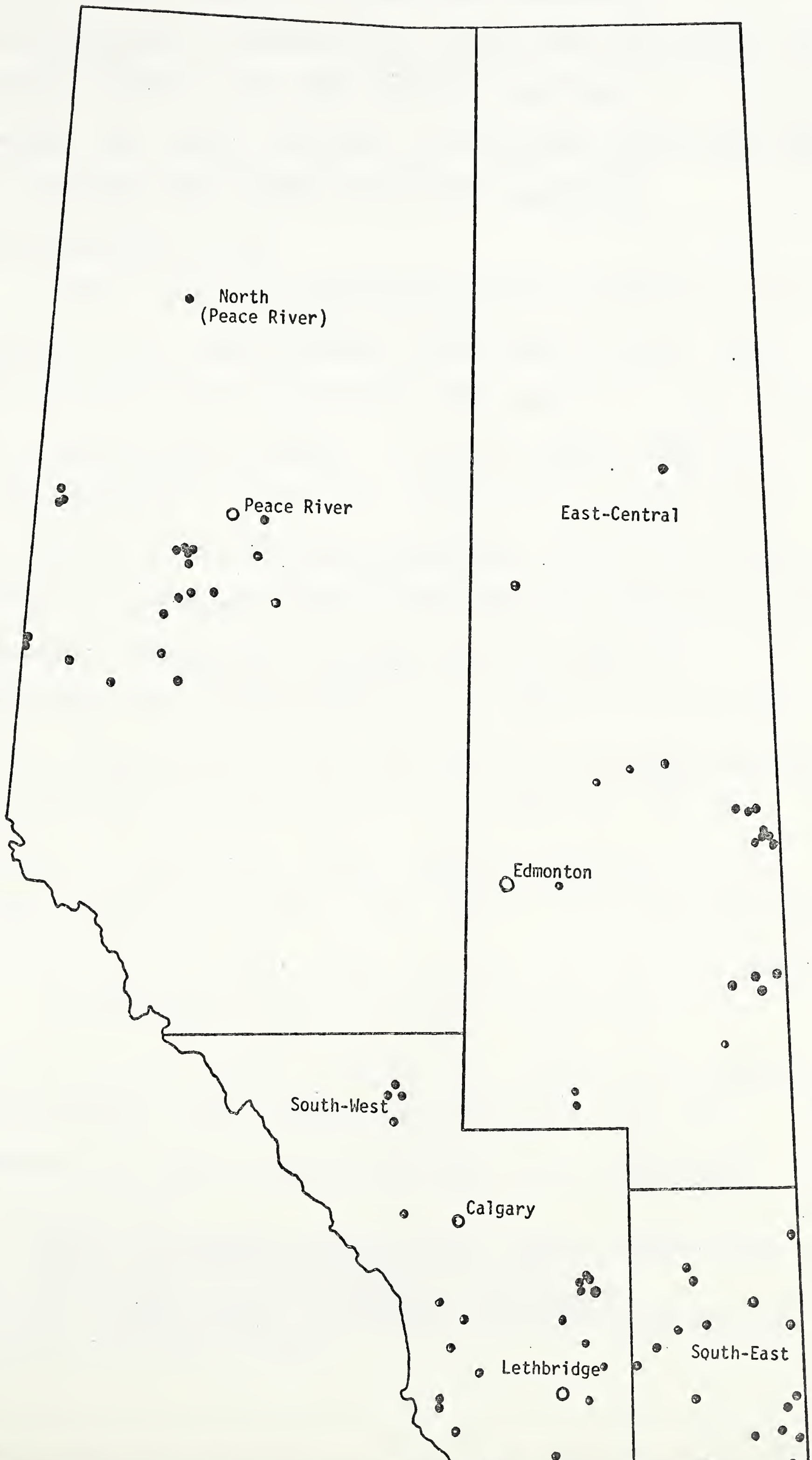
In the process of designing an adequate sampling frame of grazing associations that would satisfy the needs of this study and yet minimize data collection costs, the province of Alberta was divided into four major sample regions. Grazing associations tend to cluster in four areas of Alberta(Figure 2.2) Reasons for this clustering are not known; however, it may be inferred that these are areas of high pasture need.

Regionalizing the sample enables different enterprise-region relationships to be described. A short description of each region and characteristics(based on census data) follows, with an emphasis on regional differences which promote different farming methods and enterprise combinations. Four Alberta census regions that geographically approximate the four study regions were selected to illustrate farm characteristics in a region. Census farm descriptions reported below represent typical Alberta farms, while survey results represent only typical Grazing Association patron farms.

North Region (Peace River Area)

Located in the north-west corner of Alberta, this

Figure 2.2. Location of Grazing Association in the Study Regions



Source: Lands Management & Development Branch, Alberta Energy and Natural

region remains as one of the last homestead possibilities in Canada.[13] It starts near Fox Creek and extends north to the 60th parallel and west to the B.C. border. The region is known as the Peace River area and it accounts for 22(26%) of the 84 assocation pastures(Table 2.2).

These northern associations have a combined cattle population of approximately 7,124 head or about 3% of the region's cattle and serve 150 patrons or about 3% of the region's farm owners.[14] In this region there are approximately 7 members per association and 47 cattle per member in each association(Table 2.4). The average number of acres per head is 22 acres, the highest in the province. Comparable stocking rates set by the government for this region are 2.5 and 2.7 acres per A.U.M.(Table 2.5).[15] The difference in acreage rates is due partly to excess available acreage per head and partly to averaging. Unused land(ie., sloughs, lakes, bush) is not taken out of the total acreage(insufficient information), giving a high estimate of acres per head.

Endowed with soils of varying composition and quality, this region is noted for production of cereal and oilseed crops. Located in the Boreal zone of Alberta, the soils range from dark grey, dark grey

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[13]This region is compared with Alberta Census Peace River region. There are 7 Alberta Census regions.
[14]Head means cows,bulls,heifers,and yearlings.
[15]An A.U.M. is the amount of forage required to supply one cow with a calf for a month.

Table 2.4. Association Pastures by Region (1974).

Region	%	N	Acres		Members		Stock	
			mean	std. dev.	mean	std. dev.	mean	std. dev.
North	26	22	7144	4957	6.8	2.9	323.8	213.3
East-Central	25	21	9629.5	7666	14.6	11.7	730	943.3
South-East	20	17	19204	9870	28	19	1066	987
South-West	29	24	10438	16978	22.8	38.1	1018	1940.6
Mean:	25	21	11603.7	9868	18	18	785	1021
Total:	100	84	11147	11717.9	17.7	24	773.9	1234.6

Region	Acres		Members		Stock	
	min.	max.	min.	max.	min.	max.
North	320	22361	1	14	68	745
East-Central	155	25265.5	0*	41	0*	4264
South-East	762	33951	0	71	0	4249
South-West	636.8	82305.7	4	177	86	8668
Total:	155	82305.7	0	177	0	8668

Region	Region Totals					
	N	acres	members	stock	stock/member	acres/stk
North	22	157158	150	7124	47	22
East-Central	21	198234	406	15330	50	13
South-East	17	326470	483	18122	38	18
South-West	24	237792	547	24357	45	9.7
Total:	84	919654	1486	64933		

*0 indicates that one pasture is not used at present.

Table 2.5. Stocking Rates by Zone (Acres/A.U.M.)

Zone	Excellent	Good	Fair	Poor
1	3.3	4.3	5.6	8.6
2	2.7	3.3	4.3	6.2
3	2	2.4	3.3	4.3
4	1.2	1.5	2.0	2.7
5	2.5	3.3	4.3	5.6
6	2.7	3.8	4.7	5

Source: Alberta Agriculture, Alberta Range Pastures, Agdex 134-14 (Edmonton: ADA, 1975).

Table 2.6. Agricultural Land Values in Alberta Relative to C.L.I. Ratings (1976)

C.L.I. Class	Acreage Value ($/Acre)
1	342.69
2	215.07
3	174.43
4	143.78
5	152.31
6	137.48
7	140.22
9	134.46
Unspecified	87.23
Total Province	177.36

Source: R.L. Prather, et al., 1976 Agricultural Real Estate Values in Alberta, Agdex 822-1 (Edmonton: ADA, 1977).

Table 2.7. Regional Farm Characteristics (1976)

Characteristics	North	East-Central	South-East	South-West	Province
Average Farm Size: (acres)	757	785	1507	1233	864
Farm Assets ($):					
Land and Buildings:	$136,362	162,517	316,090	365,765	234,120
Machinery:	32,370	32,114	56,148	45,580	36,318
Average Operator Age: (years)	45	47	47	48	47
Number of Farms:	8,120	10,153	8,332	7,604	57,130
Cattle/Farm:	27	72	127	115	80
Wheat Yields: (bushels/acre)	21	27	26	28	22
Farm Area Owned (%):	76	70	55	52	64

Source: Alberta Agriculture, Alberta Census of Agriculture 1976 (March 1978), pp. 1, 29, 57, 99, 127.

Note: The number of farms for 4 census regions totals 34,209(60%) of all farms provincially. Three regions are excluded.

wooded, and grey wooded to Solonetzic types. The topography varies from flat land to rolling land to very steep coulees.

Climate of the region is subhumid and extensive tree cover extends north from the southern parkland boundary near Fox Creek. Rainfall is usually adequate(16-18 inches per year) and the frost-free period lasts from 75-90 days. Excess water is a frequent problem and often impairs crop harvest s.[16]

Settlement in the Peace River region is extensive with approximately 14% (8,120) of all Alberta farms located within it. An average farm is 757 acres and the operator's average age is 45 years old(table 2.7). Small grain farms dominate this region and wheat yields average 21 bushels per acre.[17]

Farms in the region with sales of $5000 or more averaged 861 acres, had assets of $136,362 (land and buildings) and numbered 5,835 of the region's total 8,120 census farms(Table 2.3).[18] Average total machinery value per farm is $32,370 . In 1976, land for this region varied in price from less than $125 per acre

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[16]A. Bailey has done a comprehensive study of all regions with regard to grasses,rangeland, and similar facts. S. Smoliak has classed this region as parkland and woodland types.

[17]Farm Management Branch, Alberta Agriculture, Farm Management Data Manual: Vol.1(Edmonton:1976),p.112/852.

[18]A census farm is defined as"a farm, ranch, or other agricultural holding of one acre or more with sales of agricultural products during the year 1975 of $1,200 or more."Statistics Branch Alberta Agriculture Alberta Census of Agriculture 1976,(March1978).

to $200 per acre(Table 2.6).

Approximately 5% of all provincial cattle and calves are in this region and each farm averages 27 head.[19] Relative to the south, cattle populations in this region are low for two major reasons. Settlement occurred later in this region and as land was broken, it was used for higher revenue crop production. As well, development costs were higher than in the south. Also, cattle require large amounts of feed for wintering and are more labor intensive than crops.

It is interesting to note that 76% of the total farm area in this region is owned and only 24% is rented. This proportion is 12% higher than the provincial average of 64% owned land(Table 2.7). The north region is the youngest of the study regions.

East-Central Region

This region is east of the north region , extending south to the 53th parallel. Located on a fringe area of the Parkland-Boreal forest, the topography is treed and rolling. There are 21 associations(25%) of the total population located here. Regionally, they account for 15,330 cattle or 2% of the total region, and serve 306 members or 6% of the region's farm owners.[20] Associations in this region average 15 members each and 50 cattle per member.The average number of acres per

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[19]Derived by dividing total cattle and calves by number of farms.
[20] This region is compared to the Alberta Census north-east region.

head is 13, or 9 acres less than the north region(Table 2.4). This indicates that land is either less treed and more developed here or that it is better quality land. Comparable stocking rates as determined by the government are 2.5 and 2.7 acres per A.U.M.(Table 2.5).

Soils of the region are some of the best in the province. They consist of black and dark brown Chernozemes with some grey-wooded areas. Productivity of these soils is high and the frost-free period is longer than in the north region. Climatically, the east -central region is dry subhumid with rainfall from 15-18 inches per year. Frost-free days average 75-90 in this region, enabling wheat yields to average 27 bushels. There are more cattle in this area than in the north and farms tend to be mixed farms. In fact, more mixed farms exist here than in any other regions .

Farms in this region constitute approximately 18% (10,153) of all Alberta farms. The average farm size is 785 acres and the farm operators average age is 47 years(Table 2.7).

Regional farms with sales of $5,000 or more averaged 884 acres, had assets of $162,517(land and buildings), and numbered 7,685 farms of the total 10,153 census farms in the region. Average machinery values per farm were $32,114 . Land values for the region ranged from $125 to $200 per acre in 1976. Asset values indicate these farms may have more capital investment

per farm and are slightly larger in size than north region farms, but have lower asset investments compared with average provincial farms.

About 16% of the total provincial cattle and calve population is located in this region, with an average of 72 head per farm. Populations of cattle in the east -central region are 3.3 times higher than in the north region and demonstrates the higher dependency on beef for incomes. In this region 70% of the total farm areas is owned, which is higher then the provincial average of 64% (Table 2.7).

South-East Region

Set in the hottest and driest part of Alberta, the south-east region extends from the Saskatchewan border west to the 112th longitude and north of the 49th parallel to the 51st parallel. Virtually all of this region is contained within the Palliser Triangle which in 1890 was labelled as unsuitable for farming[21].

Associations located in this region number 17 or 20% of the provincial total. Accounting for a total association cattle population of 18,122 head or 2% regionally, these pastures serve 483 patrons or 11% of the region's farm owners.[22] The average number of members per association is 28 and average number of head per member is 38. This region has the second highest

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[21]See:J.Warkentine,Canada:A Geographical Interpretation,1968,p.409.
[22]This region is compared to Alberta Census southern region.

number of stock per association at 1,066 head and the average acres per head is 18 acres(Table 2.4). Government stocking rates are set at 3.3 acres per A.U.M.(Table 2.5).

Soils of the prairie grassland region are the brown and dark brown soils. These soils are low in productivity because of low nutrients and rainfall. With low rainfall rates (12-14 inches per year), droughts and hot winds are frequent. Only small amounts of these soils are productive enough for crops because of these deficiencies. The region is sparsely vegetated due to soils having high concentrations of lime and other carbonates. The climate is dry arid and 115 frost-free days exist each year. Wheat yields average 26 bushels.

Farms in this region are essentially based on beef production as a result of these conditions. The area is noted to have a competitive advantage over northern producers in beef production. Most of the provincial feedlots are located here also.

Cattle populations in this region are much higher than in the north. Here 23% of the total provincial cattle and calves are located on 15% of all provincial farms(Table 2.7). Farms average 1,507 acres and are operated by farmers averaging 47 years of age(Table 2.7). South-east farms are the largest in Alberta; they are twice as large as those in the north region. There are 5 times as many cattle here as in the northern

region and 1.4 times as many cattle as in the east-central region. Farms have an average cow herd of 127 head, 5 times as large as the north region and 1.8 times larger than the east-central region. Average farms have more cattle than average provincial farms.

Farms with sales of $5,000 or more in this region are 1,447 acres in size, have assets of $316,090 (land and buildings), and number 7,548 of the regions 8,332 census farms. Significantly higher machinery investments are recorded here at $56,148 per farm . Land prices in 1976 ranged from $125 to $200 per acre in this region(Table 2.6). Only 55% of the farm area is owned, considerably less than the north region's 76%. This indicates that farms in this area generally rent as much land as they own, have large investments in farm assets, and are more dependent on beef for income than other regions.

South-West Region

Located in the south-west corner of Alberta this foothills grasslands region encompasses the area west of the south-east region to the B.C. border and north from the 49th parallel to the 52th parallel.[23] Because of close proximity of the foothills, this region has a damper climate and more varied topography than the south-east region.

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[23]This region is compared to Alberta Census south-central region.

There are 20 associations (24%) of the provincial total in this region. These associations account for 24,357 cattle or 3% of the region's cattle population and serve 547 farmers and ranchers or 7% of the region's farm and ranch owners. Associations average 23 members and 45 cattle per member. The average number of acres per head is 9.7, the lowest in the province. Conversely, the average number of stock per association is the highest in the province at 1,018 head(Table 2.1). The largest herd(8,668) is found in this region. Land quality and development costs are conducive to high cattle numbers in the south-west region.

Soils of this area are dark brown and black, and the topography graduates from rolling prairie to steep foothills. Temperatures and precipitation vary as well, with cooler temperatures and higher rainfall(12-17 inches per year). Chinooks are noted in this area, and help to raise temperatures quickly by up to 15 degrees Celsius in one day. Frost-free days are never less than 90 days and wheat yields average 28 bushels.

The region accounts for approximately 13%(7,604) of all provincial farms. They have an average 1,233 acres and are operated by farmers with an average age of 48 years (Table 2.7). Here 19% of the province's cattle and calves are located, with farms averaging 115 head . Beef dominates this region as a productive enterprise .

Farms with sales of $5000 or more averaged 1,366

acres , had assets of $365,765 (land and buildings), and numbered 6,494 of the region's 7,604 census farms. Machinery investments per farm average $45,580 . Stocking rates for this area are the lowest provincially at 1.2 and 2 acres per A.U.M. (Table 2.5). Land values for this region are the highest provincially, over $200 per acre in 1976 (Table 2.6). In this region only 52% of the land is owned. This proportion is the lowest in the province, indicating an owned:rented ratio of about 1:1(Table 2.7).

High herd populations, beef numbers, and capital investments demonstrate the dependence placed on beef for income by producers in this region.

In summary, the four regions are quite different in a number of characteristics. Associations vary in size, cattle populations, and memberships from the smallest in the north to the largest in the south(Table 2.4). Regional variations are experienced in soils, climate, and stocking rates.

III. METHODOLOGY AND PROCEDURE

Estimation of regional input differences and outputs produced, calculations of regional production functions, and measurement of benefits or marginal productivity values as undertaken in this study are founded on concepts used inductively and deductively throughout this study. A combination of production and natural resource economics and approaches used in previous studies gives this study its foundation.

Production Possibilities of Land

The concept of land is basic to the production of agricultural products as well as non-agricultural products valued in society which include wildlife habitats, recreation areas, resorts, photogenic areas, etc. Land is difficult to define precisely. Land has unique characteristics; it is indivisible, permanent, fixed in location and supply, and is of natural origin. Land also has an identity of soil, climate, and topography which causes compatible economic growth of industries or enterprises to occur. Land is capable of an array of uses such as skiing, camping, day-trips, oil and gas exploration, photography, hunting, fishing, camping, hiking, scenic drives, and forestry. Important as a factor of production, land can be viewed as a media from which these varied products are derived.

In the classical sense, land as a factor of production gives rise to comparative or competitive advantages in production. For example, high quality land is more flexible for growing agricultural products than are lands of lower quality. Products that are derived from land can be economic products (having a market price and demand), quasi-market or extra-market products (having partial or no market prices but a demand exists), and non-measurable products (having no market prices or current demand, but having a potential future demand).

Economic or market goods, such as grain, cattle, or timber, are easily valued using market prices. Quasi-market or extra-market goods such as amenities, photography, smells, aesthetics or experiences have partial or no market for prices, and a demand is present. Hunting, a product with no market, has a value (benefit) partly recaptured through licenses or fees. Non-measurable products or goods are harder to value because of their underlying characteristics, but recognition of these values to society is becoming more evident. These goods have an option value and incur a price(similar to an insurance premium) to leave options open for the future. Knowing that a national park is only 100 miles away may be of value to a consumer in

society even if he did not visit it.[24]

Land is capable of producing many products in a multi-use fashion , and one of those products is the subject of this study.[25] Tradeoffs among the various derived products involves benefit-cost analysis and production theory approaches. A comparison of marginal products of alternative uses is critical to achieve efficient resource utilization. Resource use over time is most efficient when net benefits are maximized. Private and social efficiencies will differ due to the presence of externalities.

Public resource managers should try to allocate scarce resources to maximize net social benefits for society. Questions concerning the best use of a resource arise and in response, efficiency and equity criteria must be addressed. Allocation of resources and the incidence of resulting benefits and costs are the central facets of the problem.

Benefit-cost analysis can be used to evaluate investments of scarce resources. The techinque assigns benefits and costs to an investment so that the economic viability can be ascertained. Private planners view benefits as revenues and costs as costs incident upon

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[24]J.Krutilla, "Conservation Reconsidered",American Economic Review (September 1967),p.777.
[25]See;P.H. Pearse,"Principles for Allocating Wildland Among Alternative Uses", Canadian Journal of Agricultural Economics (February 1969),p.121. A. Scott,"An Economic Framework for Choosing Among Land Uses", Forestry Chronicle (March 1963),p.45.

them. Public planners should take into account all private and external benefits and costs in decisions.

The economic goal of the analysis is to determine the maximum net value of benefits. In other words, maximum net benefits are determined by summing benefits and costs over time, and discounting the stream back to the present for alternative uses. From the analysis, a benefit-cost ratio, net present value, and internal rate of return may be derived, and the best use selected. Problems in implementing the analysis must be recognized.

Pricing problems arise where externalities are evident due in part to some form of market limitation.[26] Indefinite or unstable property rights may similarly promote an externality. Private time horizons may differ from optimal social ones in terms of intertemporal use rates or conservation states and cause externalities.

Another problem is assigning monetary values to all benefits and costs so a complete analysis can be made. Such intangibles as noise, and the presence or lack of scenic amenities have no price and are therefore hard to quantify. A complete analysis on resource use requires first, that the allocation question be answered and second, that the incidence of benefits and costs be

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[26] See; S.V. Ciriacy-Wantrup, Resource Conservation: Economics and Policies, 3ed ed., University of California Press, 1968. ;D. Gardner, "Transfer Restrictions and Misallocation in Grazing Public Ranges", Journal of Farm Economics, vol.44(1962), p.50.

identified.

Private planners consider only benefits and costs incident upon their firm, while public planners must include all benefits and costs, regardless of incidence. This study shows the incidence of benefits and costs of public pastureland consistent with this rationale.

Land used for grazing purposes is a destructible renewable stock resource. [27] Resources of this type have a biological origin and interact or exist with living organisms. Initially set out as a stock resource, land can be depleted for a period and later self-regenerate new stocks. Resources of this type can be expanded in stock; however, renewals or increases in new stock occur at a biological rather than a man-induced rate(man may affect the rate, though).

A graphic model to explain optimization of intertemporal allocation between uses of public land is given in Figure 3.1. Current and future periods of social benefits and private costs are located in the north-east and south-west quadrants, respectively. The problem is to determine optimal allocation of resources between the two periods. The solution is as follows. Future stocks for consumption are comprised of biological regeneration rates of the resource plus

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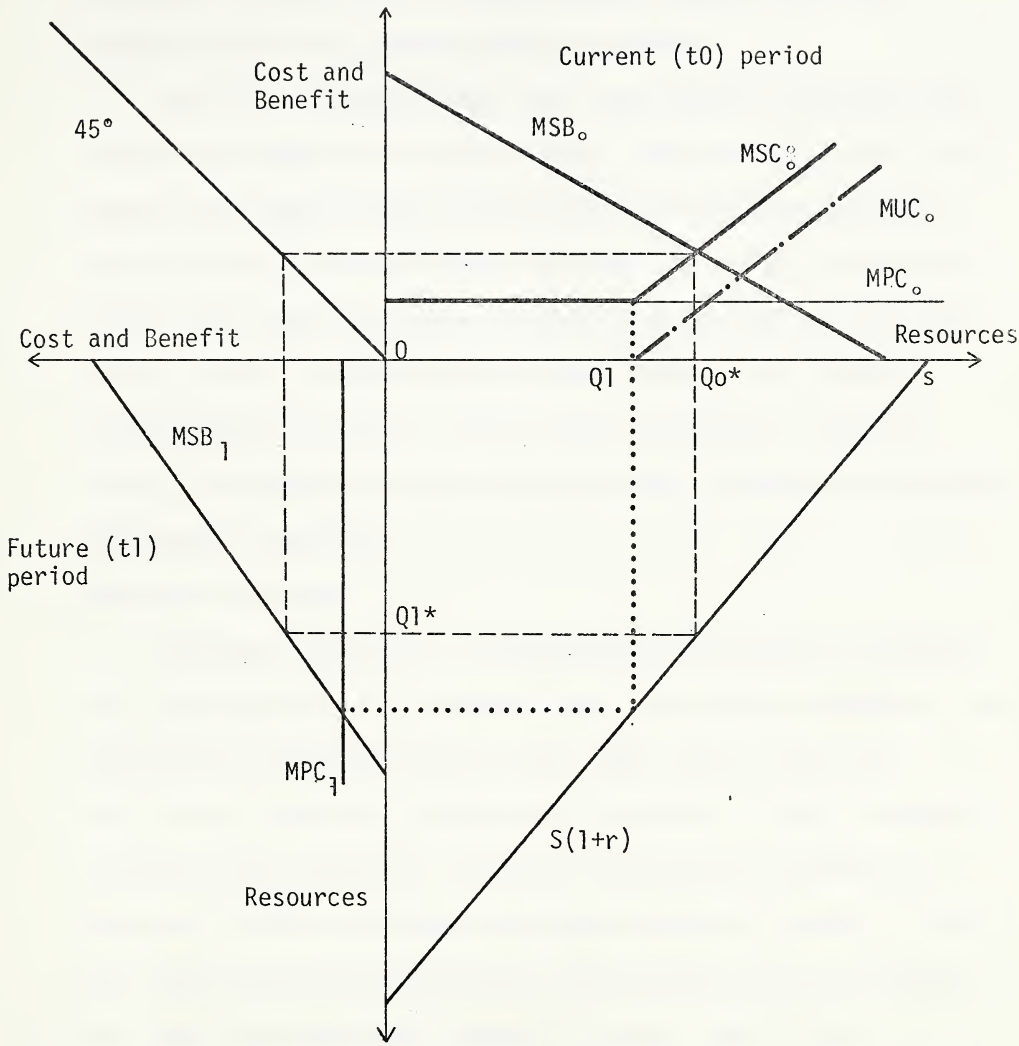
[27]J. McInery,"The Simple Analytics of Natural Resource Economics",<u>Journal of Economics</u>(1976).

Figure 3.1. Optimal Resource Use Over Time



leftover period t0(current) stocks.[28] If consumption in period t0 is Q1 or less, no effects (depletion) on future consumption are experienced. If more than Q1 is consumed in period t0, future(user) costs rise.The former would be a conservation process.

With no consideration for the future, private use of land is where MPC equals MSB. Addition of a user cost means the supply curve shifts left and hence, optimal use(currently)is where MSC and MSB are equal. Resources of Qo* are used, leaving (S-Qo*) for period t1. In the future, Q1* is consumed(quadrant three) and through assumptions of current prices and revenues, the use rates (intertemporally) are equal for current and future discounted benefits.

Relevant Studies

Studies relevant to estimation of marginal values for acreage used for grazing are not widely evident. Few published Canadian works exist that deal with the efficiency criteria of grazing on public lands. However, combined with several relevant production economics studies the few studies available should provide a basis for measuring marginal value of pasture.Grazing demand for land is a derived demand by farms and by an industry, therefore an estimate of the marginal value

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[28]MPC(marginal private costs) are constant over time, and future stocks consist of S(1+r). S is a stock and r is the regeneration rate. If r increases, the line S(1+r), pivots out from axis point s and future supplies increase. MSB(marginal social benefits) represents a demand curve, and MSC(social costs) represents a supply curve.

should be made.

Recently published Canadian studies have used a benefit-cost approach and valued pastures on an A.U.M. basis. The studies have tried budgeting, linear programming, and simulation approaches.

A socioeconomic evaluation of P.F.R.A. pasturelands by Phillips, Anderson, and Toma revealed significant net social benefits accruing from an array of uses. Using a benefit-cost approach to analyze use patterns, the pasturelands were found economically viable. Results on an A.U.M. basis were $20.46 and $16.88 for two pastures.[29]

Barichello's approach was to optimize a hypothetical farm's production using an L.P. to show farm responses to increased pasture supplies. Concluding that public pastures are a poor investment with negative rates of return, he states they are not viable for certain B.C. areas, using an A.U.M. value of $9.[30]

On-going research by Graham uses a similar linear programming approach to measure pasture benefits in a ranching model. This interesting study values an A.U.M. at $10-15 indicating higher benefits to grazing.[31]

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[29] W.E.Phillips,M.S.Anderson, D.M.Toma,<u>An Evaluation of the PFRA Community Pasture Program</u>, Edmonton:M.S.Anderson & Associates Ltd.,1978.
[30] R.R.Barichello,<u>An Economic and Distributive Evaluation of Community Pasture Programs</u>, Department of Agricultural Economics, University of British Colombia ,1978.
[31] J.D.Graham,"Estimates of the Value of Pasture to Cow-Calf Ranches:Case Studies Using Linear Programming" Department of Agricultural Economics, University of British Colombia,1977.

Wiens calculated pasture values on an A.U.M. basis for beef farms in the Prairie parkland region. A budgeting approach was used and results indicate values of $8/A.U.M. A programming model for beef-forage-crop analysis developed by Harrington to reflect B.C. conditions, generated A.U.M. values of $10-11.[32]

Generally it can be stated that approaches in the past have varied, with A.U.M. values ranging from $9 to $20. Variations are due to price differences and gains on pasture.

Several authors employed another method to measure marginal value of pasture. Deeded land values are based on expected returns(assuming no adverse influences). Deeded lands with grazing permits to other lands have been noted to be higher in sale value than comparable lands without permits. This indicates the marginal product of the leased land is high and this is capitalized into the sale price. By measuring this estimated lease value, a marginal value can be estimated.

Martin and Jefferies made the analysis and obtained A.U.M. values of $1.08(state land) and $1.75(forest land) in the U.S. Similarily, this issue was examined in Alberta by Forbes .[33]

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[32]See:Barichello,Ibid.

[33]W.Martin,Jefferies,G."Relating Ranch Prices and Permit Values to Ranch Productivity",Journal of Farm Economicsvol.48(1966),p.233; L. Forbes,"An Analysis of the Relationship Between Sale Values of Public Grazing Leases and Sale Values of Comparable Private Range Lands in

Southern Alberta Grazing Associations note that inflating deeded land values having a lease, is presently an on-going practice. An auctioning process is mentioned by these authors as appropriate means to capture the economic rent of the leased land.

Integrative approaches using production theory and output tradeoffs have been attempted in the U.S.. Federal grazing benefits to a region were estimated using investment multipliers. Regional impacts of beef were simulated using A.U.M. values of $9.81 to $11.23 as a basis.[34] Similar approaches have been tried, substituting other outputs for grazing.[35]

Several other production function studies have relevance for estimation of a beef production function. Weins studied the tradeoffs of forage and crop production on grain-cattle farms in Saskatchewan. As prices of the crop outputs changed, production moved to those higher revenue earning crops, that is, marginal land was shifted from forage to crop production as grain prices rose.

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[33](cont'd) Southern Alberta" (MSc. thesis, Utah State University, 1965).

[34]H.F. Heady _et al_, "Livestock Grazing on Federal Lands in 11 Western States"_Journal of Range Management_, Vol.27No.3, (May1974),p.174.

[35]_Nation's Range Resources--A Forest-Range Environmental Study_ Forest Resources Report #19, (U.S.D.A., 1970); O.T. Kingma and J.A. Sinden "Towards Practical Guidelines for Multiple Use Management"_Canadian Journal of Agricultural Economics_, vol.23(November1975),p.59.

Another Saskatchewan study was done by Sorboe.[36]. The sample(49) was stratified by size and surveyed for costs and returns. As prices changed, movements were made to capitalize on them. Returns to producers varied as to sizes, beef production systems, yields, and crops produced, and management(a hard thing to measure).

Chao analyzed beef production functions for Nova Scotia farms. The sample (17) was selected from 5 counties for homogenity of farm size, organization, and operation. Data were collected and output was specified as gross returns per head. Independent variables used were: bushels of barley fed(total digestible nutrients T.D.N.),tons of hay fed, acres of improved pastures, man-hours of labor, and variable costs (minerals, vet services, depreciation, utilities, taxes, marketing). The double-log form proved most accurate. Results were decreasing returns and an R^2 of 97.9% for a cow-calf operation.[37]

A study of Peace River farms by Mackenzie specified a beef production model. He tried to estimate input-output relationships for factors, by using quantity of beef produced per farm per year as the dependent variable. Independent variables were: number of cows, quantity of roughage and pasture (T.D.N.),

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[36] M.Sorboe,"An Economic Analysis of Grain-Beef Cattle Farms in the Lloydminster-Battleford Area of Saskatchewan", Canadian Farm Economics,Vol.11No.2,1974

[37] C. Chao,"Beef Production from Sample Farms in Nova Scotia", Canadian Farm Economics,Vol.19No.3,1971,p.50.

quantity of concentrates (T.D.N.), quantity of labor used, square feet of animal shelter, value of livestock equipment and improvement per year, and variable costs. Results of this study were more accurate using animal unit months as the basis for variables. Out of 11 linear regression models, 2 had the best fits with R^2 values of 95% and 44%. The second fit is more realistic since it incorporates pastures and feeds and thereby avoids previous multicollinearity problems.[38]

Production function research has been explored in depth by many U.S. authors. Heady and Dillon compiled most of the previous works in terms of methodolgy, principles, and concepts. A study of livestock production by Heady utilized variables similar to Mackenzie's work.[39] Approaches developed by these various authors appear consistent with respect to theory and logic. Similar variables and functional forms used indicate a communality shared in most cases.

This study undertakes a similar estimation of production functions. The functions are used to generate marginal products and returns to scale. Estimation of net social benefits derived from public pasture land are made using a benefit-cost analysis. The analysis is completed by showing the incidence of the benfits and costs.

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[38] J.MacKenzie,"Beef Production -Peace River Area of Alberta",(MSc.Thesis University of Alberta,1966).
[39] E.Heady,J.Dillon,<u>Agricultural Production Functions</u>(Ames:Iowa State University Press,1961).

Sample Design

Data requirements for production functions to be estimated and for a benefit-cost analysis to be made are large. Since grazing associations are dispersed throughout Alberta, the procedure stated below was used to gather the data.

As specified previously, Alberta was stratified into four major regions of study. A priori reasoning based on criteria of homogeneity (location of pastures, population in the area, climate, soils, enterprise types and sizes) helped formulate the basis for stratification. In this study probability sampling was employed and randomness was retained to allow for inferences to be made about the population. Sufficient patron samples existed in each region to use stratified random sampling.

Because of time and financial constraints, a sample of 80 farmers and ranchers was specified as sufficient for this study's analysis. A secondary consideration was adequate degrees of freedom in testing by virtue of the fact that 20 samples per class reproduces population characteristics.[40] Sampling for the 80 patrons amounted to alloting a quota of 20 per region, and administering in-person questionnaires to 20 randomly selected farmers and ranchers in each region. The procedure included a random selection of three associations per region, and

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[40]See:W.Yang, Methods of Farm Management Investigations,FAO paper#80(Rome:FAO,1968).

from the three, 20 patrons were randomly selected for interview. Government lists of associations and patrons were used in this endeavor.

Sampled associations in each region varied by membership size, availability for interviews, and responsiveness to the study. Sample problems were encountered, and the ideal quota allotments were not achieved. Farmers active in farm work were unavailable at interview time in some cases. Farmers denied interviews and missed appointments in others. In the north and east-central regions, 4 associations were selected for sampling of patrons. Patron samples achieved in the two regions were 17 and 23, respectively, with the other two southern regions attaining 20 samples each(Table 4.1). Farmers in the south-east region were not very responsive and complained of being over-surveyed. A total of 5-8 samples refused an interview, prompting an alternate to be used.

Once the samples were selected within regions and associations and contacts were made, interview questionnaires were administered by the author. Interviews generally lasted one to one and a half hours. Data collection began in early summer and extended over five months due to intermittent cropping patterns. With consistent responses appearing in the interviews, sample errors were minimized.

Extensive differences such as association size, membership, allotment, and carrying capacity of the pasture, exist among the regions. Associations sampled generally increased in size of acreage, membership, and stock numbers from north to south. This size increase is consistent with regional descriptions as explained in Chapter II. Allotment differences by associations indicate distribution problems, and allotments ranged from a high of 1,291 A.U.M.s per member to a low of 0 A.U.M.s for the sample associations. Tne highest individual allotments existed in the south-west region(Table 4.1).

IV. FARM SURVEY RESULTS

Findings of this study are presented in the next three chapters in accordance with the three objectives set out in chapter I. Results of the member profile, in physical and economic terms, are discussed first. Member profiles detail farm sizes, enterprise combinations, and pasture dependencies. Farmers and ranchers using grazing associations throughout Alberta are located in different environments. Consequently, enterprises, farm practices, and attitudes tend to differ spatially. This section details spatial similarities and differences among patrons.

The next section presents current problems that the patrons feel exist. They fall into two areas, internal (management) and external (competing use) problems.

A. Farm Sizes and Descriptions

The belief that pasture patrons are small farmers, who put 20-30 head on pasture each summer, is widely held by patrons and government officals. Results of this study refute this belief, through both allotment and farm herd size evidence.

In some associations, allotment and internal problems exist. However, most associations do not have these problems. Provincial allotments average 224 A.U.M.s, or 59 head per patron. The highest individual allotments occur in

the east-central region (1,125 A.U.M.s) and the lowest in the north region (0 A.U.M.s). The south-west region averages the highest allotments per member(Table 4.1). Stock numbers per patron indicate associations allot less than 90 head per member in all but three associations sampled. One association averages a high of 106 head per patron, while in the south-east region, one association averages only 9.5 head per patron. This spread of allotments and stock per patron implies that equal allotment distributions among members are not widespread. More discussion on this matter is found in the section on land-use conflicts.

Farm sizes, assets and net worth estimates are measures of performance and are used in this study for descriptive purposes. Sample farms averaged 1,144 acres(463 hectares) provincially, and ranged in size from 81 acres to 9,000 acres (Table 4.2). On a regional basis, the largest average farms were found in the south-west region (1,405 acres), followed by south-east farms (1,184 acres), east-central farms (825 acres), and northern farms (729 acres). This order of size makes sense since land quality generally is better in the north and poorer in the south. Therefore, farms in the south require a larger land base to make an economic unit than in the north. Farm sizes differed slightly(Table 2.7) from 1976 census farms.

Total assets[41] of grazing association members averaged $520,522 per farm provincially, with south-west farms having

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[41]Valuations by patrons at interview time.

Table 4.1. Sample Associations by Region

Region and Association	Acres	Patrons	Stock	Samples	Allotments (A.U.M.s) Mean	Min.	Max.	Stock/Patron
North:								
Big Valley	320	5	91	4	30	0	89	18.2
Long Valley	4829	7	279	5	180	101	236	39.8
Campbell	7680	5	381	4	339	68	370	76.2
Little Smoky	11086	14	745	4	223	0	1291	53.2
Mean:	5979	8	374	4.25	193	42	497	46.7
East-Central:								
Jake's Butte	3983	17	329	5	100	65	110	19.3
North Group	10571	7	645	5	332	285	430	92.1
Clear Hills	11258	15	705	6	232	113	1125	47
Blackfoot	24550	51	1363	7	110	6	240	33.2
Mean:	12590	20	760	5.75	194	117	476	38
South-East:								
Fincastle	772	28	268	8	47	37	48	9.5
Comrey	30330	22	1321	7	199	117	388	60
Pipeline	29954	21	1096	5	310	107.5	372.5	52.1
Mean:	20352	24	895	6.6	185	87	270	37.2
South-West:								
Castle River	6159	9	287	7	121	28	182	31.8
East Burnstick	9816	5	531	4	556	150	610	106.2
Waldron	20023	95	8668	9	290	15	945	91.2
Mean:	12000	36	3162	6.6	322	64	579	87.8
Province:								
Mean:	12730.2	22	1297.7		223.5			59

the highest asset value of \$878,084 per farm(Table 4.2). Lowest regional average asset values were found in the south-east region at \$277,170 per farm. Total assets were composed of land, building, machinery, and livestock owned by the farmer. In financial terms, land has the greatest weight in measurement of total assets due to demand pressures currently occurring in the province.

Land had the highest provincial average asset value of \$231,010 per farm , followed by livestock at \$96,550 per farm, machinery at \$64,790 per farm, and farm buildings at \$63,580 per farm(Table 4.2). After accounting for land investment differences, asset investments agree with a priori reasoning regarding regional production. Highest machinery investment occurs in the north (\$92,050 per farm), likely due to the high dependence on grain production. In the east-central region, an almost even split between livestock (\$75,080 per farm) and machinery (71,890 per farm) assets fortifies the mixed farming characteristic of this region's farms. The two southern regions have the highest investments in livestock.

According to census data, the highest machinery investments occur in the south-east region and the lowest in the north region. This is contrary to survey results. The census shows that land and building assets are highest in the south-west region and lowest in the north. This is in partial agreement with survey results. Differences in data are due in part to inflation of machinery prices, land and

building cost increases, a reversed cattle cycle, and other market adjustments since 1976.[42]

Farmers were asked about major liabilities regarding land and machinery assets. Provincially, land liabilities average $46,096 and equipment liabilities average $18,986 per farm(Table 4.2). In all regions except the north, land liabilities were greater than equipment liabilities. In the north, equipment liabilities were larger, indicating expansion on farms and an intensive use of capital for crop production.

For the province, a net worth for farms was approximated with these figures, at a value of $307,232 per farm. Highest average net worth was realized in the south-west ($423,890) and the lowest net worth in the south-east ($212,640)(Table 4.2). Again, a net worth is determined largely by the values placed on land assets in each region and is a relative measure with which to compare differences among regions.

Breeding cow herd sizes averaged 87 head per farm provincially, while total head of cattle averaged 208 per farm provincially and A.U.s averaged 120 per farm(Table 4.2). Using these measures, the south-west region had the highest average number of cattle, while the north region had the lowest average number per farm. This result is in partial agreement with census data(Table 2.7), and is

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[42]A comparison between Census and survey data is made, but does not imply Grazing Association patrons are typical farmers of a region.

Table 4.2 Patron Farm Description

Region	Sample Farm Size (acres)	Assets per Farm ($) Land ($x10^2$)	Bldgs. ($x10^2$)	Machinery ($x10^2$)	Livestock ($x10^2$)	Total Assets per Farm($)	Liabilities ($) Equipment ($x10^2$)	Land ($x10^2$)	Net Worth of Land & Machinery ($x10^2$)
North									
mean	729.4	1484.0	496.4	920.5	214.4	311897	264.0	200.0	2292.2
st. dev.	428.8	859.4	384.5	504.0	176.5	117209.6	276.7	126.6	1340.2
cases	17	17	17	17	17	17	15	13	17
East-Central									
mean	825.2	1640.3[d]	549.1	718.9[a]	750.8[a]	367732	116.8	333.7	2863.8
st. dev.	528.9	982.9	384.0	588.0	696.9	200093.8	72.6	281.4	1553.3
cases	23	23	23	23	23	23	10	8	21
South-East									
mean	1183.7	1327.7[d]	605.5	484.0	695.7	277170	103.1	383.0	2126.4
st. dev.	818.0	878.8	353.0	299.7	543.4	176889.8	87.4	240.1	1334.8
cases	20	20	18	20	20	20	11	10	20
South-West									
mean	1404.8	3779.4[a]	748.8	678.0	1531.3[a]	878084	287.0	670.0[c]	4238.9
st. dev.	1905.0[b]	3419.7	704.4	617.6	2407.1	774886.0	293.5	425.2	3434.4
cases	20	20	18	20	20	20	11	8	20
Province									
mean	1144[c]	2310[c]	635.8[c]	647.9[c]	965.5[c]	520521.9[c]	189.86[c]	460.9[c]	3072.32[c]
st. dev.	1105.5[b]	2103.2	473.4	532.5	1348.5	47515.4	227.24	309.47	2247.91
cases	80	80	76	80	80	80	47	39	78

Table 4.2 Continued

Region	Total Head of Cattle	Number of Horses	Number of Tractors	Number of Trucks	Number of Granaries	Animal Units	Herd Cows
North							
mean	75.6	2.5	2.4	3.0	10.8	49.8	40.1
st. dev.	58.9	2.8	0.8		4.7	35.8	36.9
cases	17	14	17	17	17	17	14
East-Central							
mean	201.6	8.0	2.6	2.4	8.2	125.0[a]	89.7[a]
st. dev.	193.6	6.2	0.8		4.4	115.6	70.6
cases	23	13	23	23	23	23	23
South-East							
mean	206.6	3.2	3.1	2.5	4.8	108.7[a]	89.8[a]
st. dev.	172.2	2.5	1.3		2.6	83.6	50.3
cases	20	14	20	20	18	20	18
South-West							
mean	328.6	6.5	4.0	3.2	8.7	186.3[a]	118.8[a]
st. dev.	377.0	5.9	3.7	2.3	6.0	220.9	132.0
cases	20	18	19	20	17	20	18
Province							
mean	207.8	5.1	3.0	2.8	8.1	120.2	87.4
st. dev.	244.7	5.1	2.0	1.3	4.9	140.0	84.7
cases	80	59	79	80	75	80	73

[a]Highly significantly different from north region (.01 level).

[b]The smallest (81 acres) and largest (9,000 acres) farms are located in these regions.

[c]A weighted average.

[d]Highly significantly different from south-west region (.01 level).

further evidence of regional specialization , dependency on outputs, and hence, revenues from those outputs.

Farmers using these pastures had a provincial average of 5 horses per farm with the highest average number found on east-central farms (8) and the lowest on northern farms (3) (Table 4.2).

An average of 3 tractors and 3 trucks are found on all patron farms in the province. Also evident are an average of 8 granaries per Alberta farm, with the most granaries located in the north (11 per farm), and the least located in the south-east region (5 per farm)(Table 4.2).

Another measure used to describe grazing association member farms is an enterprise breakdown and the income earning ability for the farm. Enterprises are combined on farms to generate maximum incomes according to managerial skills and values. Cow-calf operations are combined in a complementary way in all regions, while feeder operations(selling yearlings or long yearlings at 15-18 months) are not as prevalent provincially(Table 4.3). Some farmers sell calves at 8 or 10 months, while the majority keep them to feeder age. Hog operations only exist in the east-central region, again illustrating mixed farming.

Farm income[43] was broken down by major income earning categories and by enterprise types. Provincially, 61% of the patrons thought beef was the major income earner for their farm, while 21% accorded a 50:50 split to beef and grain,

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[43]Gross farm income shares perceived by operators.

Table 4.3. Enterprises as Income Sources

	North	East-Central	South-East	South-West	Province
Enterprise Combinations Operated					
cow-calf	15.0	23.0	20.0	19.0	77.0
feeders	7.0	20.0	14.0	15.0	56.0
grain	17.0	23.0	20.0	19.0	79.0
hogs	0.0	9.0	0.0	0.0	9.0
Major Income Earner					
beef	4.0	17.0	15.0	13.0	49.0
grain	5.0	1.0	5.0	3.0	14.0
1/2·1/2 each	8.0	5.0	0.0	4.0	17.0
Breakdown of Farm Income (%)					
Cow-Calf					
mean	43.3	44.3	0.0	10.0	41.8
st. dev.	5.7	20.3	0.0	0.0	19.4
cases	3	11	0	1	15
Feeder					
mean	34.2	56.9	76.9	73.5	62.5
st. dev.	15.6	23.9	30.5	30.2	30.4
cases	14	20	20	20	74
Grain					
mean	61.1	31.3	49.2	47.2	46.4
st. dev.	17.1	15.6	23.1	26.0	22.6
cases	17	19	9	11	56
Income Tax Paid (1977 $)					
mean	1480.71	1393.8[b]	1372.5[b]	4637.5[a]	2890.3
st. dev.	1001.00	1077.6	1467.2	3341.6	2870.1
cases	7/41%	6/26%	6/30%	16/80%	35/44%

[a]Highly significantly different from north region (.01 level).

[b]Highly significantly different from south-west region (.01 level).

and 18% thought grain was the major income earner(Table 4.3). A major difference between regions is in all regions but the north, farmers thought beef was the major income earner. In the north region, only 24% of the sample agreed that this was the case. In light of previous discussion on assets, this further reinforces grain as the north region's specialty.

Farm income broken down by enterprise types suggests interesting results also. Highest cow-calf income sources exist in the east-central and north regions, while feeder income sources are evident in the southern regions(Table 4.3). Grain sales for income are strongest in the north and a secondary income source in the two southern regions. This solidifies the regional differences and specializations in products sold by patrons. In the north, grain is prevalent and little beef production occurs relative to other regions. East-central region farms combine more enterprises than other farms, and southern farms depend on feeders (primarily) and grain for income.

In 1977,44% of the sample paid income tax, averaging \$2,890 per farm(Table 4.3). The east-central farms had the lowest number of farmers paying(26%), while the south-west region had the highest incidence of farmers paying (80%). This fact reflects both net worths and liabilities on patron farms by region. South-west farmers' attitudes concerning income tax were noted to be more positive then other farmers'(they accept payment more readily).

B. Patron Descriptions

Descriptions of pasture patrons, their dependencies on pastures, and their attitudes regarding operation of pastures are discussed below.

Farmers that hold memberships in associations average 49 years of age provincially, with some regional age differences apparent. The oldest farmers appear to be in the south-west region and the youngest in the north region(Table 4.4). Sixty-four percent of those interviewed had an education level of grade 9 or less, 24% had grade 12 or less, 9% had vocational training or a diploma, and 4% had some university education or a degree. A majority of those interviewed (95%) were born in Canada, and of those, 91% were born in Alberta. Of all farmers surveyed, 96% were born and raised on a farm.

Patrons surveyed stated they had farmed for an average of 39 years and at their present location for about 28 years. Farmers generally had at least one farm relocation during their farm careers. Most farmers(79%) did not inherit any lands, but of those who did, a quarter section was the usual amount inherited(Table 4.4).

Off-farm employment was an item of interest with regard to income sources of patrons. Responses indicate that 59% of farmers either have worked or currently are working on other jobs, and an almost even split is evident between part-time and full-time employment. The highest portion of farmers who

Table 4.4. Education, Age, and Farm Status of Patrons

	North	East-Central	South-East	South-West	Province
Farmer's Age					
mean	44.3	47.9	47.3	54.5[a]	48.6
st. dev.	7.0	8.6	15.5	10.0	11.2
cases	17	23	20	20	80
Number of Years Farming					
mean	33.6	39.8	37.2	46.0[a]	39.4
st. dev.	13.9	16.0	20.4	15.9	17.0
cases	17	23	20	20	80
Years at Location					
mean	23.7	28.6	25.1	31.9	27.5
st. dev.	14.6	15.0	15.1	14.8	14.9
cases	17	23	20	20	80

Educational Level		Frequency	(%)
grade 9 or less		51	64
grade 12 or less		19	24
vocational		7	9
university		3	4
cases		80	100
Birth Place		**Frequency**	**(%)**
Canada	yes	76	95
	no	4	5
Alberta	yes	73	91
	no	7	9
Farm	yes	77	96
	no	3	4

[a]Significantly different from north region (.01 level), other regions are not significantly different.

Table 4.4. Continued

	North	East-Central	South-East	South-West	Province	%
Inherited Land						
yes	1	9	2	2	17	-
no	16	14	18	15	63	-
Quantity Inherited (Quarter sections)						
0	16	14	18	15	57	-
1	1	7	2	4	14	-
2	0	0	0	0	0	-
3	0	1	0	6	7	-
4	0	1	0	0	1	-
47	0	0	0	1	1	-
Off-Farm Work Status						
Tried or currently employed in Off-Farm Work						
yes	12/70%	12/52%	12/60%	11/55%	47	59
no	5/30$	11/48%	8/40%	9/45%	33	41
cases	17	23	20	20	80	100
Job Type						
part-time	10	6	2	5	23	49%
full-time	2	6	10	6	24	51%
Time of year worked						
spring	1	0	0	0	1	2%
summer	0	3	2	3	8	17%
winter	8	3	1	2	14	30%
all year	3	6	9	6	24	51%

work(70%) are in the north region, while other regions average about 55%(Table4.4). A majority of the jobs consist of year-round work (51%) and winter work (30%). It appears employment is sought when labor is freed from farm duties, and cash flow problems are probable.

Members state they have used the pastures for an average of 17 years, and they either bought into it, were told of it by neighbors, or were one of the original founders(Table 4.5). A majority (90%) of the present patrons have been consistent users of association pastures, and a majority (93%) of them also feel the present pricing policy is fair.[44]When asked if they could use more public grazing land, 65% of all members responded with a 'yes'. This response was consistent in all regions but the north, where 71% said no more land is required(Table 4.5). In the farmers' view, the optimal product-product mix may have been achieved, that is to say, the land base, management factors, and other required inputs are presently fully employed as factors of production.

When asked if alternative land supplies could be found, a majority (90%) of the respondents stated that no other lands were available. Sources of available land for the other 10% were their own land (implying a reallocation within), neighbors's land, and other lands.[45]

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[44]Pricing is set by the membership on a break even basis.
[45]A PFRA pasture is periodically available in the south-east region, and grazing reserves are available in other parts of Alberta.

Table 4.5. Association Pasture Patron Attitudes

	North	East-Central	South-East	South-West	Province
Number of years using pasture					
mean	13.2	18.0	18.5	18.2	17.1
st. dev.	9.0	9.5	9.6	8.6	9.3
cases	17	23	20	20	80
Could you use more land?					
yes	5/29%	13/57%	17/85%	17/85%	52/65%
no	12/71%	10/43%	3/15%	3/15%	28/35%
Could you find alternate pasture without this association pasture?					
yes	2	5	1	0	8/10%
no	15	18	19	20	72/90%
Where?					
neighbor	-	3	0	0	3
own lands	2	2	-	-	4
other	-	-	1	-	1
none	-	-	-	-	72
How much of a herd decrease may result without the pasture? (%)					
mean	85.0	53.2	41.4	95.2	67.5
st. dev.	17.8	22.2	24.7	12.7	29.7
cases	16	22	20	20	78

Table 4.5. Continued

	Province
Learned about association pasture from:	
neighbor	41
one of the founders	38
other	1
Have you ever quit using pasture?	
yes	8/10%
no	72/90%
Is the present pricing fair?	
yes	74/93%
no	6/ 7%
Would you have to decrease your herd without the pasture?	
yes	78/98%
no	2/ 2%

When asked about the possibility of having to decrease herd sizes through a lack of pastures, 98% of the patrons responded that an average decrease of 68% in herd size would occur. Highest reductions would be experienced in the south-west(95%) and north (85%) regions(Table 4.5).[46]

Distances from the pastures averaged 15 miles for members provincially, with no appreciable differences among the regions. In the south-west region, farmers drove an average of 25 miles to pastures(Table 4.6).

When asked about maximum distance a farmer would go, replies averaged 41 miles provincially. A high of 55 miles in the south-east region indicates a willingness to travel farther than other regions' patrons.

Questioned about the possibility of increasing the present carrying capacities on pastures with no improvements, 90% of all patrons stated no increases were possible. When asked about using water sources as an improvement to achieve the same goal, 91% felt water was of no help. Such improvements as burning, reseeding, brushing, and breaking were then proposed as possibilities and 59% of the patrons responded that these improvements would help. For this question, the highest number of positive responses came in the east-central(90%) and in the north (70%) regions. Since brush problems are expected here, these responses are not surprising.

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[46]Decreases may not be as high since a reallocation within depends on input and output prices to dictate location on the L.L.C.C.

Table 4.6. Patron Location and Pasture Improvements

	North	East-Central	South-East	South-West	Province
Patron Distance from pasture (miles)					
mean	13.4	12.0	12.8	25.3	15.4
st. dev.	12.1	7.2	10.4	24.5	14.3
cases	16	23	18	13	70
Maximum distance patron would go (miles)					
mean	25.8	43.9	54.7[a]	37.1	41.2
st. dev.	24.0	28.9	33.1	32.0	31.0
cases	17	23	20	17	77
Could the association pasture carry more cattle now?					
yes	1/ 6%	7/30%	0/ 0%	0/ 0%	8/10%
no	16/94%	16/70%	20/100%	20/100%	72/90%
How many more cattle with all improvements? (%)					
mean	68.3	79.5	25.2	27.2	63.7
st. dev.	27.2	24.0	9.3	22.5	31.5
cases	13	23	5	5	43
With more water?					
yes	3/17%	0/ 0%	2/10%	2/11%	7/ 9%
no	14/83%	23/100%	18/90%	17/89%	72/91%
Would improved pasture conditions help?					
yes	12/71%	22/96%	3/18%	9/50%	46/59%
no	5/29%	1/ 4%	17/72%	9/50%	32/41%

[a]Highly significantly different from north region (.01 level), other regions not significantly different.

If all necessary improvements were made on the pasture land ,patrons thought that up to 64% more cattle(provincially) could graze on these pastures. The highest perceived increases were in the north and east-central regions, while in the south, members did not think very large increases were possible at all without harming land productivity.

Asked about numbers of cattle kept at home and on association pasture, patrons reported an average of 63 head on home summer pasture, and an average of 88 head on association pasture each year(Table 4.7). In the north and south-west regions, fewer cattle are kept at home than on association pasture on average. One reason for this difference is more pasture demand exists in other areas, causing member allotments to be nearly the same, that is, higher allotments are available to north and south-west region farmers. The highest average number of stock per member also exists in these two regions(Table 4.1).

C. Farming Practices

Inventories of cow breeding herds have been decreasing generally for the last few years. When asked about the change in the last two years in this respect, 60% of the farmers(provincially) responded that no changes had been made in herd size. Only 38% of the members stated a decrease in the last two years(Table 4.8). An exception to this general trend was evident in the north region where 53% of

Table 4.7. Patron Cow Herd Sizes

	North	East-Central	South-East	South-West	Province
Usual number of cattle on association pasture					
mean	73.2	53.0	52.8	176.2	88.3
st. dev.	58.9	43.1	45.5	224.3	128.4
cases	17	23	20	20	80
Usual number of cows at home					
mean	7.0	68.4[a]	72.9[a]	85.0[a]	63.4
st. dev.	2.8	56.4	72.4	67.6	63.8
cases	11	21	16	17	65
Last two years' changes in cow herd numbers					
increase	2	0	0	0	2/ 2%
decrease	9/53%	10	3	8	30/38%
constant	6/35%	13	17	12	48/60%
cases	17	23	20	20	80
Expected next two years' changes in cow herd numbers					
increase	0	3	0	2	5/ 6%
decrease	6	0	1	5	12/15%
constant	11	20	19	13	63/79%

[a]Highly significantly different from north region (.01 level), other regions not significantly different.

Table 4.8. Cropping Practices (1977)

	North	East-Central	South-East	South-West	Province
Acres Crop					
mean	355.7	287.6	228.1	511.8	343.4
st. dev.	191.8	162.8	154.1	674.1	369.2
cases	17	23	17	18	75
Acres Pasture					
mean	177.0	649.8[a]	2345.0[a]	1109.2[a]	1088.0
st. dev.	136.7	707.6	2828.2	2094.9	1936.2
cases	17	23	20	19	79
Acres Lease					
mean	244.4	1080.9	1133.4	717.9	825.5
st. dev.	185.9	1009.6	628.6	568.8	763.0
cases	17	23	20	20	80
Crops Grown					
wheat	8.0	7.0	17.0	8.0	40/50%
oats	7.0	21.0	12.0	11.0	51/64%
barley	16.0	20.0	10.0	12.0	58/73%
repeseed	15.0	2.0	8.0	2.0	27/34%
other (rye)	0.0	1.0	0.0	0.0	1/ 1%
Did you use fertilizer in 1977?					
yes	15.0	20.0	4/20%	14.0	53/66%
no	2.0	3.0	16/80%	6.0	27/44%
cases	17	23	20	20	80

[a]Highly significantly different from north region (.01 level), other regions not significantly different.

the farmers reported a reduction and 35% reported a constant herd population for the last two years. Reasons stated for such changes were price-related. If a farmer believed it were not profitable to keep cattle, he would reduce his herd. In other words, farmers keep herd size to a level manageable(financially) at current prices.

Perceptions regarding the next two years were again price-related. If a farmer believed prices would increase, he indicated a building program; if prices were thought to be falling, he indicated a selling program. Of the respondents, 79% stated a constant number would be kept on the farm, 15% stated a decrease would be iniated (to take advantage of current high prices), and 6% stated a herd increase would be attempted(Table 4.7). Recent high cattle prices are generally promoting herd inventories to be built up on farms.

Allocation of land between crop and pasture was examined in this study. Provincially, farms averaged 343 acres of crop and 1,088 acres of deeded pasture with the south-west region having the highest averages of both for all regions. An estimate of association leased land on a per farm basis averaged 825 acres provincially, with the south-east region having the highest average (1,133 acres) per farm, and the north having the least (244 acres) per farm(Table 4.8).[47] These results agree with average farm

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[47]Estimated by dividing total A.U.M.s alloted to a farm by total association A.U.M.s, and multiplying by total association acreage to give available acreage for a farm.

sizes and regional differences already discussed(Table 4.2).

In 1977, the distribution of crops grown varied with each region. Of the patrons interviewed, 73% grew barley, 64% grew oats, 50% grew wheat, 34% grew rapeseed, and 1% grew rye. Regionally, the northern farmers specialized in rapeseed and barley, the east-central farms emphasized feed grains, south-east farms grew wheat, and south-west farms grew wheat, oats, and barley with no major emphasis on any one crop(Table 4.9). Fertilizer used in 1977 was favored by 66% of the patrons provincially. Only in the south-east region was fertilizer not used by a majority of farmers (80%). This phenomena is largely due to the lack of rainfall available for dissolution of the chemicals.

In 1977, land was rented by 60% of the farmers (provincially) and the highest frequency of rentals occurred in the east-central region where 78% of the patrons rented land(Table 4.9). Additional pastureland was most favored for rental(46% of patrons provincially). In the north, 86% of the patrons rented extra cropland, adding credence to the notion of unemployed resources (labor,machinery) there. Rental arrangements most favored were the total cash basis (63%) and the crop share basis(37%). Only in the north region was the distribution different; there, 86% of the renters favored a crop share arrangement(Table 4.9). Arrangement differences are due to the high amounts of cultivated land rented in the north as opposed to the rented pasturelands in the south.

Table 4.9. Forage Production

	North	East-Central	South-East	South-West	Province
Rental Practices					
Did you rent last year?					
yes	7/41%	18/78%	13/65%	10/50%	48/60%
no	10/59%	5/12%	7/35%	10/50%	32/40%
Type:					
cultivated	6/86%	4/22%	0/ 0%	0/ 0%	11/23%
pasture	1/14%	8/44%	12/92%	10/100%	22/46%
other	0/ 0%	0/ 0%	0/ 0%	0/ 0%	0/ 0%
both	0/ 0%	6/33%	0/ 8%	0/ 0%	15/31%
Arrangement:					
per acre	0/ 0%	0/ 0%	0/ 0%	0/ 0%	0/ 0%
total cash	1/14%	10/56%	12/92%	7/70%	30/63%
crop share	6/86%	8/44%	1/ 8%	3/30%	18/37%
cases	7	18	13	10	48
Forage System Favored					
square	6/ 3%	20	20	8	54/70%
round	10/63%	2	0	1	13/17%
loose	0	0	0	6	6/82%
silage-forage H.	0	0	0	3	3/ 4%
other	0	0	0	1	1/ 1%
cases	16	22	20	19	77/100%
Production in hay last year (tons)					
mean	257.1	216.6	120.0	305.8	230.9
st. dev.	173.2	204.0	156.4	329.3	234.0
cases	16	23	13	18	70
Purchases of hay last year (tons)					
mean	14.0	66.0	153.8	55.2	96.0
st. dev.	0.0	53.2	249.5	59.8	168.1
cases	1	6	13	12	32

Hay forage systems employed were square balers (70%), round balers (17%), and loose hay stackers (8%)(Table 4.9). The north region differed in that 63% of the farmers used round balers and 38% used traditional square balers. Three reasons may account for this. First, a labor shortage in the area may have stimulated round baler use since it is a significant time-saving machine. Secondly, the climate of the area is normally adverse, and these machines lessen the risk of damaged hay crops. Finally, since the average age of farmer in the region is the lowest provincially, the tendancy is greater toward innovation and reception to recent advances in technology.

Production of hay last year(1977) averaged 231 tons per farm and purchases of hay averaged 96 tons per farm provincially(Table 4 .9). In all regions more hay was produced than bought, except for the south-east region(Table 4.9). Due to poor rainfall and drought conditions in 1977 ,poor crop conditions existed and a deficit arose in this region.

Culling of cows by members was done for reasons of health, age, poor calves, no calf, no teeth, or poor feet. The most frequent time of culling was fall(71%), followed by both spring and fall(19%), and then spring 10%)(Table 4.10). A majority of farmers(56%) chose to give an unbred cow a second chance, while 46% of the farmers would not. Average replacement age of cows was stated by farmers to be 11 years old provincially, with the south-east region's farmers

Table 4.10. Cow Herd Management Practices

	North	East-Central	South-East	South-West	Province
When do you cull?					
spring	0.0	3.0	0.0	4.0	7/10%
fall	13.0	13.0	13.0	9.0	48/71%
both	3.0	5.0	2.0	3.0	13/19%
What is done with unbred cows?					
sell	1.0	9.0	0.0	2.0	12/46%
another chance	2.0	6.0	2.0	4.0	14/54%
Replace cows at what age?					
mean	10.2	11.8	9.2	11.1	10.7
st. dev.	3.0	1.2	1.3	2.2	2.2
cases	9	13	9	7	28
How many heifers are kept each year?					
mean	12.4	11.1	14.1	24.8	15.3
st. dev.	9.6	6.7	10.2	24.9	14.9
cases	16	22	19	17	74
Heifer age of breeding (months)					
mean	15.8	13.9	13.2	14.1	14.1
st. dev.	4.4	3.7	3.7	3.4	3.8
cases	13	22	19	17	71
Heifer weight of breeding (lbs.)					
mean	726.9	740.0	663.1	685.2	704.2
st. dev.	97.0	81.1	95.5	91.4	94.3
cases	13	22	19	17	71
Have you ever or do you now use artificial insemination?					
yes	7.0	8.0	4.0	9.0	28/36%
no	10.0	15.0	15.0	10.0	50/64%
Normal calving months					
January	2.0	2.0	0.0	1.0	5/ 7%
February	5.0	5.0	0.0	9.0	19/25%
March	6.0	11.0	5.0	6.0	28/37%
April	4.0	4.0	14/74%	1.0	23/30%
June	0.0	1.0	0.0	0.0	1/ 1%

culling at an average age of 9 years. This lower replacement age is due to both climatic conditions and cultural practices such as winter grazing. An average of 15 heifers per year are kept provincially, with a high of 25 being kept in the south-west region. These replacements are bred at an average age of 14 months and an average weight of 704 pounds. Most farmers calve their cows out in March. Other favored months for calving (ranked by preference) are April, February, January, and June. Regionally, the south-east differs since 74% of the farmers favor April as the calving month. This preference is due to breeding patterns and climate influences in the region.

Calving rates average about 92% for all farms sampled(Table 4.11). Herd bulls generally are sold for slaughter at a replacement age of 5 years. Replacements are made due to either association rules or cultural practices. New herd bulls are primarily bought from bull or auction sales (63%), although other purchases are made through breeders and neighbors(Table 4.11).

Farmers were asked about artifical insemination practice on the farm and if it was used currently or ever. Thirty-six per cent of the patrons responded 'yes'and 64% responded 'no'. Reasons cited for not using it are time required, extra animal management, expenses, and cattle prices.

Breeds of cattle favored ,in order of descending popularity, are Hereford, Angus, Shorthorn, and Charolais.

Table 4.11. Cattle Purchases and Sales

	North	East-Central	South-East	South-West	Province
Cattle Breeds					
pure	2.0	4.0	12/60%	7.0	25/31%
cross-breeds	15.0	19.0	8/40%	13.0	55/67%
Hereford	2.0	4.0	12.0	6.0	24
Angus	4.0	4.0	5.0	3.0	16
Shorthorn	3.0	4.0	2.0	2.0	11
Charolais	7.0	5.0	1.0	3.0	16
Simmental	1.0	4.0	0.0	4.0	9
Others	0.0	1.0	0.0	2.0	3
Where do you purchase cattle if you do?					
auction sale	5.0	4.0	2.0	7.0	18/23%
neighbor	0.0	1.0	0.0	0.0	1
breeder	0.0	0.0	0.0	0.0	0
agent	0.0	2.0	0.0	0.0	2
don't ever	12.0	16.0	18.0	13.0	59/74%
Calving Rate (%)					
mean	91.7	90.8	91.5	92.4	91.5
st. dev.	3.9	5.2	4.0	3.8	4.3
cases	13	23	19	17	72
Bull sales					
breeding	0.0	0.0	0.0	1.0	1.0
slaughter	15.0	20.0	10.0	13.0	58.0
Replacement of Bulls (yrs. kept)					
mean	3.2	4.3	4.1	3.7	3.9
st. dev.		1.5	0.9	1.2	1.2
cases	17	22	17	17	72
New purchases from					
neighbor	2.0	4.0	0.0	4.0	10.0
breeder	0.0	5.0	5.0	6.0	16.0
bull on auction sale	14.0	13.0	12.0	6.0	45/63%

Table 4.11. Continued

	North	East-Central	South-East	South-West	Province
Cow Grazing in fall (days)					
mean	45.0[a]	27.5	52.0[a]	60.0[a]	46.7
st. dev.	14.1	14.7	16.5	17.3	18.6
cases	10	8	15	7	40
Feeder Grazing in fall (days)					
mean	35.0	39.0	60.0	30.0	38.1
st. dev.	8.6	13.4	0.0	0.0	12.3
cases	3	5	1	2	11
Cattle watering practices at home					
well	7.0	19.0	12.0	10.0	48/61%
dugout	9.0	2.0	7.0	3.0	21/27%
other	1.0	1.0	1.0	7.0	10/13%

[a]Highly significantly different from east-central region (.01).

Cross-breeding is favored by 69% of the farmers provincially, although in the south-east region cattle are crossed by only 40% of the patrons. Hardiness of the Hereford is noted by farmers as a reason for not crossing their cattle with other breeds. Seventy-four percent of those surveyed state they never purchase cattle for their herd (other than bulls). The most favored places to purchase cattle are country auctions or cattle sales(Table 4.11).

When cattle are removed from summer association pastures in fall, they graze other pasture and stubble for 46 days,before going to a feedlot. Feeders generally graze an average of 38 days and then go to winter feedlots. In the east-central region, cows graze a low average of 28 days in fall, whereas in the south-east ,cows graze a high average of 60 days in the fall. Cattle watering at home is done by wells(61%), dugouts(27%), and sloughs or creeks(13%).

Winter feeding averages 164 days for cows, and 171 days for feeders(Table 4.12). Feeders are fed to an average age of 15 months and to an average weight of 741 pounds.

Farmers averaged 33 years of raising beef, and 19 years of finishing beef (selling 12-18 month old feeders at weights of 700-900 pounds)(Table 4.12). Regionally, farmers in the south-east region have raised and finished beef the longest, while in the north it is a newer practice. One point of interest is that all farmers surveyed have been or currently are in the cow-calf business, whereas 74% of them do keep or have tried keeping calves until feeder weights.

Table 4.12. Beef Feeding Practices

	North	East-Central	South-East	South-West	Province
Cow feeding (days)					
mean	191.2	167.7[b]	140.8[a]	158.5[a]	164.2
st. dev.	26.8	35.4	24.2	28.5	33.9
cases	17	23	19	17	76
Feeder feeding (days)					
mean	195.4	179.1[b]	140.3[a]	168.2[a,b]	171.1
st. dev.	10.3	26.9	22.1	32.1	30.9
cases	15	21	16	14	66
Age feeders sold (months)					
mean	15.2	14.8	15.4	15.0	15.1
st. dev.	5.5	4.9	3.5	5.4	4.7
cases	17	23	20	18	78
Weights of feeders sold (lbs.)					
mean	732.3	791.3	686.2	747.4	741.4
st. dev.	174.9	198.0	121.7	205.5	179.2
cases	17	23	20	18	78
Years raising beef					
mean	23.1	32.5[a]	34.8	40.4[a]	33.0
st. dev.	8.0	14.7	19.6	20.8	17.5
cases	17	23	20	20	80
Years finishing beef					
mean	16.7	23.9	25.8	34.4[a]	18.8
st. dev.	8.3	16.2	25.1	15.2	19.3
cases	11	19	15	14	59

[a]Highly significantly different from north region (.01 level).

[b]Highly significantly different from south-east region (.01).

The remainder sell calves at weaning time in November.

In summary, sample farms averaged 1,144 acres(463 hectares) in size and were 15 miles from the pastures. Herd sizes averaged 87 breeding cows and patrons are primarily dependent on beef for their income. A majority of farmers (90%) stated that no other pasture was available and that an average decrease of 68% in beef herd sizes would occur without the association pasture.

D. Current Problems

Problems encountered by members of grazing associations were internal and external. Internal problems are management or operational problems that are handled by the membership. External problems arise from difficulties in government policy or alternative land uses like hunting.

Internal Problems

Management or membership problems are infrequent and usually minor. However, one particular problem is unequal allotment distributions among regions(Table 4.1). Several reasons for these differences are noted. Some associations initially started out as private individual leases. When the association was formed to occupy that lease, a majority of the allotments often went to the previous leaseholder as a consideration. Also, allotment differences for some southern associations occur as a result of its entity (ie. a society). Associations operating as societies offer

debendtures to members and offer allotments on a share basis, thereby leading to an unequal distribution of allotments. Allotment differences also occur when fathers pass their allotment on to a son, or individuals transfer their share over to a brother in a particular year.

Other management problems relate to municipal taxes and lease improvements. In some areas of Alberta,municipalities charge school or education taxes on the marginal lease land. Members feel this is not justified. However land taxes are a problem of local nature, and can be dealt with by members at the municipal level.

A problem that is in part both internal and external relates to public land improvement. Lease improvements are generally avoided if possible or are delayed due to insecurity of lease property rights. Members feel more government assistance is necessary to stimulate improvements since investments are not secure. Until recently, a further disencentive to undertake improvements had been low cattle prices. Although lease rights are generally renewed promptly, association members feel range improvements would not be to their best advantage. Conversely, members realize that improvements such as breaking, reseeding, or spraying to control brush will contribute to enhanced wildlife habitats.

Any postponement of these improvements means a decline in carrying capacities for cattle and wildlife due to brush encroachment and higher future improvement costs. Wildlife movements are evident onto neighboring farm crop and pasture lands[48] The Alberta Fish and Wildlife Division attempts to influence methods used to improve pastures. Efforts to date have had little effect on planning or improvements. Conflicting department policies in the government and unclear lines of authority have prevented much progress in this respect. The central theme of most policy is a single-use orientation of government lands. Public grazing land has few other uses occurring on it at present. The Division notes that more intensive grazing systems or better range management practices would promote efficient land utilization and multiple-uses of the land.[49]

A wildlife problem noted in the northern region was predation by wolves and bears. This is a year-round local problem not found elsewhere.

External Problems

Problems of this nature occur as a result of government policy and other uses of public land. For example, unclear or deficient policy causes farmers to avoid managing the pastureland to its potential.

Recreation pursuits like hiking or camping compete for

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[48] An opinion offered by east-central members.

[49] The Saskatchewan Fish and Game Branch has recently clarified hunter-farmer policy on public pasturelands. No hunting is allowed on land where cattle are still grazing.

the same land and lead to conflicts, if policy is unclear.

Competing or complementary land-uses(coexistent with cattle) may also be considered as alternative use patterns. These uses involve an array of services or products to satisfy demands of other interest groups in society. Pricing of these products may or may not be possible, depending on whether they are market or extra-market goods. Scenic views, natural amenities, and recreation actitivies are some of these products.

A current alternative use of association pastures is oil and gas exploration for well sites. This use occurs year-round and accounts for some revenues for a few associations in the province. In the future, increased exploration and pipeline construction is highly probable on pastureland. A disruption of ground cover and environments for both livestock and wildlife is implied. The current or future extent of these disruptions from oil and gas projects is not known.

Hunting and associated activities are frequently mentioned as staggered uses(occurs after the grazing season) of the land entailing conflicts. Complaints range from broken or cut fences and opened gates to rustled cattle and destroyed vegetation. A high frequency of the former two is noted throughout the province. Due to the possiblity of such occurences, members remove cattle as early as possible, prior to the

hunting season. This problem relates back to a property rights problem in that leases on public land are off-limits to trespassers, but roadways on the leases are not.

One final alternative use category of these lands relates to scientific, educational, and recreational endeavors. Most of these uses (and associated conflicts) take place near high population centres. Pressure for these needs has been sufficient to prompt withdrawal of from 1 to 14 quarters of pastureland from three different associations in the past. Reductions in memberships or allotments results from such actions.

In the south, use of recreational four wheel drive vehicles to traverse the range often destroys vegetation and ground cover. In certain parts of the province, this may have serious consequences for the fragile ecosystem (as is evidenced by "blowouts" in the Taber area).[50]

As a result of these conflicts or problems, various groups interested in the use of public land have formed certain attitudes. Some groups think farmers have the priority in land use. Farmers' attitudes indicate genuine approval with regard to allowing others to use the land as well. Clear government policy regarding multiple use of public lands is lacking in regards to these concerns. With the inherent flexibility of the land base, more clearly defined property rights and

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[50] A blowout occurs when the wind creates a gully in an area of disturbed ground cover.

co-operation with others to develop participation areas are needed. In other words, if public land is capable of many uses, then it should be dealt with as such. An evaluation of land-related policies addressing these uses and needs of the public is required. Public land can serve many in society, therefore a movement towards this goal would attain a more optimal allocation of resources in society.

V. MEASUREMENT OF PASTURE VALUE

Two approaches are used to estimate value of pasture for both patrons and society. These approaches are production functions and budgeting methods. The production function illustrates the effect grazing acreage has on farm total beef output, and hence, how acreage affects size of a farm. The budgeting method is used to derive the direct contribution that pasture makes to a patron and to society. Other current land uses are reflected in the analysis in order to show that pasture benefits are not only incident upon the pasture patrons.

A. Production Inputs

Production inputs perceived by operators to have a positive marginal product are employed in the production of beef. This section explains the inputs selected for inclusion in the estimation of function parameters for the province and for regions.

Classical theory defines inputs in three categories; land, labor, and capital. This classification has limitations, but for clarity purposes, each category is used to classify different inputs. Because of its many forms, capital as a category is not reflective of substitution or scale effects that may take place on farms.

Breeding cows are thought to explain in part the amount of beef production on farms. The number of beef cows per farm averaged 87 for the entire sample. A high average of 118 cows per farm is evident in the south-west region, while a low average of 40 cows per farm was found in the north region(Table 5.1).

Total farm assets composed of land, building, machinery, and livestock values were expected to explain beef production.[51] All farms using grazing associations averaged $520,521 per farm in assets. A much higher average of $878,084 per farm is found in the south-west region due to the high land values in the region. In the south-east region, $277,170 in average assets per farm is the case.

Variable costs affect beef production on a farm. These costs averaged $19,492 per farm provincially. The south-west region had the highest variable costs of $26,844 per farm. A low of $15,776 per farm was evident in the north region, in agreement with the lowest cattle numbers. Variable costs included periodic costs (accounting costs, utilities, taxes, marketing costs, custom work done, veterinary bills, interest, rent), feed costs (hay, grain, supplements, and salt purchased), and a depreciation charge on equipment. Depreciation charges were estimated according to the proportion of income from beef as a part of the total farm enterprise.

The last variable used to explain beef output was the

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[51] Valuations made by operators.

Table 5.1. Input Data for Regression (1977)*

	North	East-Central	South-East	South-West	Province
Total Pounds of Beef Produced					
mean	37715.29	51502.5	56100.0	90505.0	59472.7
st. dev.	24505.97	43062.0	39984.2	97102.7	60475.7
cases	17	23	20	20	80
Breeding Cows					
mean	40.1	89.7[a]	89.8[a]	118.8[a]	87.4
st. dev.	36.9	7.06	50.3	132.0	84.7
cases	14	23	18	18	73
Assets ($)					
mean	311897.0	367732.0[c]	277170.0[c]	878084.0[a]	520521.9
st. dev.	117209.6	200093.8	176889.8	774868.0	475157.4
cases	17	23	20	20	80
Variable Costs ($)					
mean	15776.76	17587.69	18225.8	26844.6	19492.8
st. dev.	6731.8	7018.7	7699.5	20455.0	12152.5
cases	17	23	20	18	78
Total Labour (hrs.)					
mean	2100.23	2998.6	1646.3[b,c]	2792.1	2403.1
st. dev.	760.0	2273.2	878.8	1500.0	1618.5
cases	17	23	19	15	74
TDN Fed (tons)					
mean	175.9	277.5[a]	146.4[b,c]	270.0[a]	221.3
st. dev.	74.9	199.1	107.0	195.4	165.8
cases	17	23	20	20	80

*Variables: crop acres, deeded pasture, and association pasture used in 1977 are tabulated in Table 4.8.

[a]Highly significantly different from north region (.01 level).

[b]Highly significantly different from east-central region (.01).

[c]Highly significantly different from south-west region (.01).

total digestible nutrients (T.D.N.)fed per farm per year.[52] Estimates were made using either operators' quantities to be consumed aggregately for the beef herd, or using estimates of normal requirements needed per head for winter feed. Quality differences were noted in feeds and an aggregation was done on a T.D.N. ton basis. An average of 221 tons of T.D.N. was required for all sample farms. The south-west farms fed a high of 270 tons of T.D.N. on average. Lowest feed requirements appeared in the south-east region with 146 tons per farm due to the short winters, winter range grazing, and cultural practices.

Land inputs required for beef production on farms were broken down into three types. On a farm, crops are grown and residuals may be used directly as grain and straw, or indirectly as stubble grazing. Therefore one variable used was crop acres.

Deeded land is composed of both native and improved pasture on a farm, plus bush land. Problems of accurate estimates by different type prompted aggregation into one variable called deeded pastureland acres.

Grazing association pasture has a significant effect on beef output for a patron and is therefore included as a explanatory variable. Calculation of this variable on a per farm basis was explained previously. Estimates of these three variables are found in Table 4.8, and are described in

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[52] T.D.N. are expressed in tons. Coefficients used for aggregation purposes were from, F.B. Morrision,Feeds and Feeding(Ithaca:Morrison Pub.Co.,1951); and A. Cullison,Feeds and Feeding(Virgina:Reston Pub.Co.,1975).

the preceding section.

Labor inputs can be described as three types; operator labor, family labor, and hired labor. Aggregation was done using hour units per farm per year for all beef-related operations. Provincially, an average of 2,403 hours is required per farm to maintain and produce beef(Table 5.1). Regionally, the most labor(2,998 hours) is required on east-central farms, and the least labor needed is found on south-east farms(1,646 hours). Although it is that noted average breeding cow numbers are the same for both regions, the major difference in hours is expected to be due to winter feeding and checking on cattle.

Since it is unclear in comparing average farm figures by region, calculations of these variables was done on an animal unit(A.U.) basis(Table 5.2). Total A.U.s on a farm were divided into each variable to give averages per A.U. per region for a year.

Beef output on an A.U. basis averaged 494 pounds provincially, with a surprising high of 757 pounds per A.U. occurring in the north and a low of 412 pounds found in the east-central region. This result for the north occurs with a large investment of inputs (Table 5.2).

Assets per A.U. average $4,338 per farm provincially, with highest average investment in the north at $6,262 and the lowest in the south-east region at $2,941 per A.U. These findings are consistent with previous asset aggregation results.

Table 5.2. Animal Unit Comparison (1977)*

	North	East-Central	South-East	South-West	Province
Beef Produced (lbs.)	757.33	412.02	516.09	485.93	494.78
Assets ($)	6262.99	2941.85	2549.86	4714.54	4337.68
Variable Costs ($)	316.80	140.70	167.67	144.13	162.16
Crop (acres)	7.14	2.30	2.09	2.74	2.85
Deeded Pastures (acres)	3.55	5.19	21.57	5.95	9.05
Association Pastures (acres)	4.90	8.64	10.42	3.85	6.86
Labor (hrs.)	42.16	23.98	15.14	14.99	19.99
TDN Fed (tons)	3.53	2.22	1.34	1.45	1.84

*Calculated by dividing region averages for each category by total A.U. averages (Table 4.2) and using acreage averages from Table 4.8.

Variable costs per A.U. average \$162 provincially, again with the highest costs in the north (\$316), and a low of \$140 found in the east-central region.

Crops grown per A.U. averaged 3 acres on all patron farms. The highest average occurred in the north(7 acres) and the lowest average occurred in the two south regions(2 acres per A.U.).

Deeded pasture acres per A.U. averaged 9 acres per farm or 2 acres more than association pasture acres. In the south-east region, a high of 21 acres per A.U. was alloted, while the lowest number of acres per A.U. was found in the north region.

Available association acres were calculated at 7 acres per A.U. per patron farm for the province. The south-west region had the lowest available acres, 4 per A.U., while the south-east region alloted the highest at 10 acres per A.U. Generally allotments are in accordance with regional carrying capacities.[53]

Labor averaged 20 hours per A.U. for all patrons. Highest labor needs were found in the north region(42 hours per A.U.), and the lowest requirements were evident in the two southern regions(15 hours per A.U.).

Feed requirements averaged 1.8 tons per A.U. provincially for winter maintenance and growth. Highest requirements are evident in the coldest region(the north) at 3.5 tons per A.U., and the lowest needs are in the

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[53]Alberta Lands and Forests, Range:Its Nature and Use, Publication No.146(Edmonton:Alberta Agriculture,1973).

south-east region at 1.3 tons per A.U.

In summary, of the three input categories described for beef production, the highest investments of all stated inputs per A.U. occurred in the north region. For example, the north region required the most investment in capital and labor inputs per A.U. while lowest investments were found in the south-east region. Highest crop investments per A.U. were found to be in the north region, the lowest in the south-east region. Highest pasture requirements (both types) per A.U. were evident in the south-east region, with the lowest found in the north and south-west regions.

Data liable for bias are estimates of T.D.N. fed and feedlot days. Operators had poor recollection of amounts fed and separations of quantities between animals. Hence, total amounts perceived to be fed were used as an estimate of the variable.

The previously discussed eight independent variables were used to account for variation in beef production and allowed twenty functions to be estimated. Criteria of R^2, F-ratios, coefficient weights, and multicollinearity checks were used to select five functions for discussion. In total two provincial and eight regional functions were estimated. Both linear and double-log forms were estimated.

Provincially, the best fit appeared to be with a linear form, including eight variables and achieving an R^2 of

Table 5.3. Production Function Parameters (Best Regional Fits)*

	North	East-Central	South-East	South-West	Province
X_1 Cow Numbers	362.17 (396.271)	424.86[c] (110.735)	-	388.73[c] (98.214)	284.27 (53.24)
X_2 Farm Assets ($)	-.25[a] (.161)	.033 (.031)	.023 (.02)	.049[c] (.014)	.41[c] (.009)
X_3 Variable Costs ($)	1.96 (1.988)	.425 (1.188)	1.22[c] (.49)	.253 (.500)	.87[c] (.300)
X_4 Crop (acres)	135.43[b] (70.324)	57.0[a] (33.883)	n.s.	-18.847[b] (8.894)	20.55[c] (7.820)
X_5 Deeded Pasture (acres)	137[b] (78.8)	-16.233[b] (8.234)	4.32[c] (1.69)	-	3.93[c] (1.570)
X_6 Association Pasture (acres)	102.46[b] (59.258)	-3.957 (4.910)	-1.65 (3.89)	7.843 (12.156)	-5.64[a] (3.650)
X_7 TDN Fed (tons)	378.98[c] (115.891)	-	14.28 (24.15)	25.973 (29.161)	48.99[c] (20.35)
X_8 Labor (hrs.)	-19.38 (17.953)	1.625 (3.596)	20.70[c] (3.53)	8.599[b] (4.423)	2.56[a] (1.76)
Positive Signs	6	5	5	6	7
Constant	-50754.46	-12948.9	-15434.53	-22528.07	-8659.65
Cases	17	23	20	20	80
R^2	68.6	90.12	97.13	98.43	91.13
F	2.18	19.55	73.43	107.52	91.22
Form	linear	linear	linear	linear	linear

*With deleted variables as explained previously.

[a]Significant at .1 level.

[b]Significant at .05 level.

[c]Significant at .01 level.

91.13%(Table 5.3) [54]. Based on R^2 changes, the most significant explanatory variables(linear form) were cow herd numbers, assets, variable costs, and crop acres on a farm.

On the basis of coefficients, large increases in output could be achieved with increased breeding cow numbers and feeding more T.D.N. A large decrease in output would be the case if more crop were grown. Beef output was highly correlated with herd cows(.88), farm assets(.79), variable costs(.76), deeded pasture acres(.65), and T.D.N.(.60). Lowest correlations were experienced with crop acreage(.08) and association acreage(.26). These results are in agreement with logic since investment in the first four variables is required to produce beef, and crop acres are competitive with beef. Association acreage as a variable offers low explanatory power. The coefficient for this variable indicates a decrease in beef output would occur with an increase in acreage use. This result is contrary to expectations. However,the coefficient does indicate that an overinvestment in this input has occurred.

All regions had 5 or more positive coefficient signs than negative signs, implying most inputs still have positive marginal products for beef production. All of the constants are negative. Of the coefficients with negative signs, land inputs occur most often, followed by capital and labor inputs. Supplies of land are inelastic, hence the

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[54] A comparison of R^2 cannot be made between linear and logarithmic forms as the log variable is transformed to a new variable.

signs imply an overinvestment in this input. Similarly, negative signs for farm assets and labor imply another overinvestment as high asset investments per A.U.(Table 5.2) are indicated. Supplies for these inputs are also inelastic.

Based on the correlation matrix, several variables were dropped (one at a time per region). The Criterion used in order to delete variables were correlations of (.8-1.0) with other variables . No significant loss was evident in the total variance accounted for, F-ratios, or coefficients.

For the north region, the best fit occurred with the linear function, having an R^2 of 68.6%, including all variables. Major explanatory variables, based on R^2 changes, were T.D.N. fed, crop acres, acres of grazing association,deeded pasture,and assets. On the basis of coefficients, large output increases are possible by increasing T.D.N. useage and breeding cow numbers. The lowest cow herd numbers are in this region(Table 5.1). Crop acres, deeded pasture acres, and association acres could also be increased to achieve the same results. Applying costs to these inputs may offset the expected increase of output.

In the east-central region the best fitting form was the linear function with an R^2 of 90.12%. The excluded explanatory variable this time was T.D.N. due to high correlations with cow herd numbers. Based on R^2 changes, major predictor variables were cow herd numbers, crop acres, and deeded pasture acres. This consistent with the

provincial linear function. Major increases in beef output could be experienced with increased use of breeding cows and increasing crop acres. Although inconsistent with logic, an increase in pasture acreage would result in a fall in production. The second highest investment of association acreage per A.U. was found in this region , which accounts for the negative coefficient sign(Table 5.2).

A best fit of production function for the south-east region was made using a linear function, achieving an R^2 of 97.13%. The variables dropped, based on high correlations, were cow numbers and crop acres. Based on R^2 changes, major explantory variables were deeded pasture acres, labor, and variable costs. Highest output increases could be gained by employing more labor and T.D.N. and increasing deeded pasture. Decreases were evident with more association pasture land being employed. The highest investment of association acreage per A.U. occurred in this region(Table 5.2). This may be inconsistent with logic if association pasture land in this region is of the same quality as deeded pasture land; if quality differences are the case, then marginal products will differ.

Using a linear function for the south-west region resulted in an R^2 of 98.43%. The excluded variable for this function was deeded pasture acreage. Variables most important were breeding cow numbers, assets, and labor. If breeding cows , T.D.N. fed, labor, or association acreage were increased in use,then output increases would result on

a farm. The lowest investment of association acreage per A.U. was found here (Table 5.2). More crop acres grown would compete however, and a fall in output would result.

In summary, the best results appeared with linear functions explaining beef production on a farm.The role association acreage plays in a farm's production of beef and, hence size, is unclear with this analysis. The most variance accounted for was 98.43% and the least was 68.6%.

Generally the best explanatory variables were cow herd numbers, deeded pasture acres, assets, and T.D.N. fed. Regional production functions implied inputs were different and investments may be required appropriately for each input. Production functions do not conclusively explain the contribution of grazing association acreage to farms. North region farms were the smallest and should increase the use of public acreage. South-west region farms were the largest and also should increase the acreage used.

Two reasons account for no direct relationship to be drawn between size(output) and association acreage. First, investments per A.U. for this variable are the lowest for the north and south-west regions(Table 5.2). This may explain the positive coefficient signs of the variable. The other two regions had the highest association and deeded pasture acreage per A.U. A second reason may be that the north region was over-capitalized in other assets and more association acreage may be needed to move the farm back into stage II of the production function. Farms in the south-west

region may be in stage I.

Surprisingly, linear forms being more accurate fits for predicting beef output are contrary to the previously discussed literature.[55] While this approach does clarify the roles of some inputs used in beef production, it is not clear from this analysis how much association acreage influences size on a farm.

The next chapter presents the results of the budgeting method. This method shows how the available acreage affects farm income. By employing this method, a total accounting of all uses can also be made. While the production function approach was concerned with only one pasture use, grazing, the budgeting method examines all pasture uses currently in place.

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[55]This was the same conclusion reached by: J.D.MacKenzie in "Beef Production-Peace River Area of Alberta"(MSc.Thesis,University of Alberta , 1966).

VI. PRIVATE AND SOCIAL BENEFITS OF ASSOCIATION PASTURES

An economic evaluation of fees paid by patrons, value of calf gains on association pastures, and net social benefits of these pastures is made below. With the best estimates of costs and gross benefits aggregated provincially, a measure of society's gain through patron use of these pastures is made. These estimates show the incidence of costs and benefits onto members of society.

A. Private Benefits

The comparison of private and public pasture fees provides some evidence of how well the price system is functioning. Private fees tend to equal public fees if the system is efficient. Fees paid by grazing association patrons in the province averaged $3.08 per month per head(Table 6.1). However, private fees averaged $5.20 per month per head. An exact comparison of fees cannot be made due to land quality differences, varied rental arrangements, and other factors. However, the fee differential does support the general belief that public lands are underpriced.[56]

The difference between these figures would mean a net lower cost per head per month of $2.12 to a patron. If this estimate was extended for a summer season, this difference

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[56]See D. Gardner, Ibid.

Table 6.1. Pasture and Associated Costs

	North	East-Central	South-East	South-West	Province
Pasture Charge per Head/Month:					
mean	$6.91	2.26	2.69	1.18	3.08
st. dev.	3.58	.96	2.12	.46	2.88
cases	17	23	20	20	80
Private Rentals per Head/Month:					
mean	$7.32	5.19	3.30	8.02	5.20
st. dev.	5.89	2.78	2.83	2.23	3.12
cases	3	18	9	9	39
Net Differences:					
per month	$ .41	2.93	.61	6.84	2.12
per summer (x5)	2.05	14.65	3.05	34.20	10.60
Marketing and Transportation Costs/Animal Unit/Year:					
mean	$6.85	5.33	4.75	6.15	5.70
st. dev.	2.56	2.52	2.91	2.62	2.90
cases	16	21	19	19	75
Veterinary Costs/Animal Unit/Year:					
mean	$4.16	3.74	2.97	5.00	3.90
st. dev.	2.81	3.07	2.32	3.20	2.90
cases	15	23	19	18	75

would amount to $10.60 per head.

Examination among the study regions revealed similar consistent conclusions with a range of fee differences of $0.41 (north) to $6.84 (south-west) per month per head. For a summer, these amount to $2.05 and $34.20 per head for each patron. If aggregated over the province, this would mean approximately $689,084 worth of nonpriced benefits to patrons(using the $10.60 figure). If this sum was allocated equally among all patrons, it would mean $463.97 per patron in nonpriced benefits.

The direct benefit of a summer association pasture to an individual is measured by the weight gains of calves, yearlings, and heifers attributed to the association pasture. Net weight changes in mature cows and bulls are not included since they are considered to be at constant weight over a year. That is, a gain in the summer is matched by a loss in the fall and winter for cows. Bulls actually lose weight over the summer due to travel and breeding. Hence, in this study, value estimates will be restricted to calves and yearlings. A majority of associations only allow cow-calf operators as members and discourage other types of animals from pasture.

Gains of calves averaged 279 pounds on provincial association pastures(estimates by respondants), with the highest gain of 306 pounds for a summer season being found

Table 6.2. Patron Benefits

	North	East-Central	South-East	South-West	Province
Calf Gain/Summer (lbs.)*					
mean	305.8	255.6	293.25	266.11	278.65
st. dev.	70.4	53.9	72.24	65.7	67.2
cases	17	23	20	18	78
Value of That Gain: (1977 prices and sale dates)					
mean	$125.76	107.47	126.2	114.4	117.8
st. dev.	28.7	25.47	31.0	28.2	28.9
cases	17	23	20	18	78

*A summer season is 150 days.

Table 6.3. Sensitivity Analysis of Values (gain by price)

	North	East-Central	South-East	South-West	Province
Price/lb. (calf 400-600 lbs.)					
$ .40	$122.32	102.24	117.30	106.44	111.46
.50	152.90	127.80	146.62	133.05	139.32
.60	183.48	153.36	175.90	159.66	167.19
.70	214.06	178.92	205.28	186.27	195.05
.80	244.64	204.48	234.50	212.88	222.92
.90	275.22	230.04	263.93	239.49	250.78
1.00	305.80	255.60	293.30	266.11	278.65

in the north region(Table 6.2).[57] Higher gains are not necessarily due to a longer season, since let-in dates are regulated and average pasture days are similar between regions. Lowest average calf gains were found in the east-central region of 256 pounds per season.[58]

Marketing and transportation costs averaged $5.70 per A.U. for all patrons (table 4.18). Calculation was done by totalling marketing, transportation, commission, and dockage fees for a farm, and dividing by the total number of A.U.s on the farm. This method achieves an average cost per head. Regionally, the highest charges are found in the north region ($6.85 per A.U.), and the lowest in the south-east region ($4.75 per A.U.)(Table 6.1). Veterinary bills (fees and medical products) paid by patrons averaged $3.90 per A.U. provincially. The highest expenses were found in the south-west region($5.00 per A.U.), and in the south-east region, lowest expenses occurred ($2.97 per A.U.). The same averaging method was used to calculate this cost per A.U. In a year of low cattle prices, veterinary costs may be lower, while in a year of high prices, they may be higher. The variation is due to the fact that value of livestock sold influences levels of veterinary use.

Calculation of the net value to an individual of putting an extra A.U. on an association pasture is therefore an accounting exercise. Total returns include(gains X

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[57]A summer season is 150 days approximately.
[58] See S. Klumph,"Cattle Gains on Provincial Grazing Reserves in Central Alberta"(MSc. University of Montana,1964), for a comparison of gains.

prices)-(marketing+transportation+vet+fees+interest charge) for an estimated net patron benefit.[59]

Clearly, this analysis shows that price is a major variable, and as output prices change, so do returns. A range of prices was selected ($0.40 to $1.00 per pound) and applied to each region's average gain. A sensitivity analysis was not required on other variables since fees are fixed by contract and run on a break-even basis. That is, association fees are set on an average cost per head to cover yearly costs. Marketing and vet charges are similarly constant.

Using costs in Table 6.1, the figures in Table 6.3 give net values to patrons. Since prices fluctuate over time, a long-run average price of $0.60 per pound is used to estimate pasture values.[60] At a price of $0.60 cents per pound, the highest net value to a patron is $146.73 and the lowest is $124.99 per A.U. for a year(Table 6.3). A range of net values exists to show benefits for different output price assumptions. Using the same price assumption, and assuming 150 grazing days, net benefits to users are $29/A.U.M. and $25/A.U.M.[61] No break-even analysis of prices or weights are made here and no cost of wintering an extra A.U. is used since it does not affect value to patron as such. Only interest opportunity costs are considered.

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[59]An interest charge of $8/A.U./season was assigned, based on commercial cattle values in 1977, and is the opportunity cost of capital.
[60]This method is used in W.E. Phillips, _Ibid._
[61]These figures compare favorably with those in table 6.7.

Additional direct nonmeasurable benefits and costs may be calculated for the pasture patrons if market values can be assigned. However, due to the nature of nonmeasurable benefits and costs, this assigning of values is not possible. These extramarket values are non-quantifiable because it is difficult or impossible to price the products. These values should be included in this analysis since they may mean a substantial difference to the patrons in deciding whether or not to use the pasture.

By using the pasture for summer grazing, some additional land, labor, and capital may be freed for use elsewhere on the farm. Land that would be used for summer grazing on a farm could be used to grow forages.Labor that would be used for supervison and management of cattle at home now is free for other activities. Most associations operate on a share basis;duties of supervison, checking, salting,and fencing are rotated among members on a weekly or bi-weekly basis. However, several associations hire riders to perform these jobs which frees the members from required duties. Hiring does not affect average costs/A.U. since there is an economy of scale effect.[62]

Another nonquantifiable benefit offered by the associations is in upkeep of herd quality through enforced breeding practices. Associations only permit purebred bulls to be used on pasture and disease is strictly controlled. In fact, new members are screened on this basis by some

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[62]Noted from patron interviews.

associations. Another benefit offered to patrons is reduced uncertainty regarding future prices of pasture requirements and availability. Group participation, government interaction, independence (as opposed to operators using grazing reserves, for example), and other reasons may be important to patrons as well.

However, nonquantifiable costs are involved. Better management practices are required in spring and fall to allocate labor and capital resources between cattle and crop activities. Co-operation with others (governments, hunters) is a necessity for group and government interaction.

B. Social Benefits

Society should try to allocate resources efficiently and equitably to all members. In this section, a comparison of social costs and benefits is made, for the province. The distribution or incidence of direct and indirect benefits and costs is clarified to show upon whom they occur.

Social direct benefits net of associated costs undertaken for livestock uses are primarily incident upon the patrons. While it is emphasized that livestock is currently the predominant use on these lands, grazing is by no means the only use. In this context, other known uses are included in the analysis.

Regional livestock benefits and costs are estimated first in the analysis. The benefits and costs of all regions are used to arrive at a net social benefit figure for the

province. Several assumptions are necessary in the analysis. Animals on summer pasture are cows with calves, yearlings, and bulls. Pasture value is estimated by measuring the calf gains on the pasture. The total head reported on pasture number 64,933. This analysis assumes 62,614 head are cows with calves. The remainder are bulls(2,319), estimated in a ratio of 1:28 (bull:cows). Yearlings are included in the calf estimates. The calving rate of 92% as determined in the survey is used in the analysis. This calving rate is applied to the 62,614 head to get an estimate of the number of calves born in 1977. No other data are available for these figures. The 150 days on pasture determined in the survey are used.

Social benefits are measured by valuing the aggregate direct benefits net of associated costs, incorporating indirect benefits and costs, and adding values of any other uses currently occurring.

A definition of some terms is useful here. Gross direct benefits are the sum total of goods and services arising from the pastures being used. If specified as a with and without criteria of projects, gross direct benefits are the difference between a region's(province's) production of beef with association pastures compared to having no pastures. Associated costs are incurred goods and services other than program costs,required by patrons, to produce and market additional beef. Net direct benefits are gross direct benefits(farm benefits) less associated costs. They are a

total return to all factors of production.

Pasture costs include fixed and variable costs. Fixed costs are lease costs and land taxes paid for a year. Variable costs are range improvements, repairs, maintenance, and bull purchases for a year.Fixed costs as reported in a survey conducted by the author averaged $2,750 for lease costs and $3,810 for land taxes in 1977. Total costs were $8,210, and variable costs were about $1,710 for 1977. By using average acres per association (11147), and average head per association (774)(Table 2.4), pasture costs can be estimated. An average pasture would have costs of $0.74 per acre or $10.88 per head per year. Regional estimates of net benefits are presented next, followed by a provincial (social) measure of net benefits.

The north region pastures consist of 157,158 acres, and serve 150 patrons, with 7,124 head of stock(Table 2.4). This would be equivalent to 35,620 A.U.M.s in a summer grazing season, 4.41 acres per A.U.M., or 22 acres per head. With the calving rate of 92%, 6,292 calves (6,839 cow units X 92%) would have been born in 1977 on north region pastures.

Direct farm benefits accrue over a summer in the form of weight gains by calves. For this region, it is 306 pounds per calf/summer, or valuing it, $125.76 per A.U.(Table 6.2). In total, regional farm benefits would be $791,282 (6,292 X $125.76) in 1977. In order to arrive at a net benefit figure for the region, associated costs are subtracted.

Associated costs must be included since additional

A.U.s mean higher costs to a farmer. Such costs are marketing, veterinary costs, and interest charges as explained before. These are \$6.85, \$4.16, and \$8 per A.U., respectively for a year. In total, additional regional marketing costs are \$48,799, and regional veterinary costs are \$29,635.84 . Interest charges are \$56,992.

Summing the weight gain benefits less associated costs gives a net benefit figure attributed to livestock: \$791,282-\$48,799-\$29,635-\$56992=\$655,856 .

For 1977, even with depressed calf prices, the north region benefitted by \$655,856 or \$18.41 per A.U.M. This is comparable to other study estimates(Table 6.7).

A similar analysis is presented for the east-central region. Total pasture acreage in this region amounts to 198,234 acres, serving 306 patrons with 15,330 head(Table 2.4). A larger number of A.U.M.s are pastured on this land, and net benefits total \$1,193,460. This figure works out to \$15.57 per A.U.M.

In the south-east region, association pastures total 326,470 acres. Utilizing these pastures are 483 patron farmers who put on 18,122 head of stock. Over a summer grazing season, this would amount to 90,610 A.U.M.s. Direct benefits calculated using methodologies similar to those already used, totaled \$1,734,953 . If converted to an A.U.M. basis, direct benefits are \$19.15 per A.U.M.

The south-west region has a total grazing association pasture acreage of 237,792 acres, serving 547 farmers and

Table 6.4. Livestock Benefits and Costs (1977)

Item	North	East-Central	South-East	South-West	Province
Total Head:	7124	15330	18122	24357	64933
Cow-Calf Units:	6839	14717	17397	23383	62336
Total A.U.M.s:	35620	76650	90610	121785	324665
Farm Benefits:	$791282	1455143	2019831	2460972	6727228
Associated Costs:	135426	261683	284878	466437	1148424
Net Direct Benefits:	655856	1193460	1734953	1994535	5578804

ranchers. Total head on pasture number 24,357 or 121,785 A.U.M.s . Due to the high number of cattle in the region, the largest number of calves were born here, 21,512 head. Regional gain data and price data from Table 6.4, give total net farm benefits at $1,994,535 or $16.38 per A.U.M.

Ignored in this analysis are the backward(induced by) and forward(stemming from) linkages that would stimulate the economy further. Usual methods to estimate this are done with a multiplier for the item[63].The method assumes resources are not fully employed or price inflation may result from investment stimulation.

In summary, it can be safely stated that significant benefits accrue to the province as a whole from land used for livestock grazing.

The analysis is complete once the incidence of benefits and costs, or distribution of measurable and nonmeasurable values associated with the pasture are made to members of society. Since the use of public land by diverse interests incurrs costs for different sectors in the province, a delineation of such costs must be made. Pasture costs incurred by patrons for 1977 are $693,484.44 or $10.88 per head on average(Table 6.8). Direct benefits to the farmers and ranchers amount to $6,727,228, while associated costs of $1,148,424 are borne by patrons as well. It should be noted

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[63]Typical multipliers for beef are 2.16,2.50,or 2.75 from M. Anderson,Oldman River Basin Study Phase II,Economic Analysis of Water Supply Alternatives (Edmonton:Alberta Environment,1978); or 1.5 from D. Bromely,"Economic Importance of Federal Grazing:An Interindustry Analysis"Journal of Range Management,vol.22(1969),p.9.

Table 6.5. Government Costs for All Association Activity (1977)*

Field Staff Involved:		
north	6	
east-central	6	
south	5	
	17	
Per Person Costs:		
travel costs	$ 334.00	
administration	$ 167.00	
salary ($20,000 @ .08%)	$ 1,600.00	(approx. 1 month)
	$ 2,101.00	
Regional Program Costs:		
north	$12,606.00	
east-central	$12,606.00	
south-east	$ 5,252.50	
south-west	$ 5,252.50	
	$35,717.00	

*Estimates by field supervisor in Department of Energy and Natural Resources.

Table 6.6. Current Pasture Uses and Farm Benefit Summary

Current Uses	1977 Direct Benefit
Livestock Grazing	$5,578,804
Oil and Gas Leases	+ve, revenue to association
Hunting (antelope, deer, moose, upland game)	+ve, revenue to province
Scientific and Recreation	+ve, no revenues

Summary of Direct Farm Benefits

Region	$ per A.U.M.
North	$18.41
East-Central	15.57
South-East	19.15
South-West	16.38

Table 6.7. Recent Canadian Studies on Pasture Values

Study*	Approach	Benefit per A.U.M.	Net Present Value	Comments
Phillips, Anderson Toma, 1978	Budgeting	$20.46 -$16.88	+	Evaluation of an array of uses.
Barichello 1977	Linear Programming	$8-9	-	Price and gain undervaluations.
DREE 1977	Simulation	$26.30	+	Opposite conclusion to above.
Graham 1977	Linear Programming	$10-$15	+	Sample insufficient for inferences.
Hill 1976	Budgeting	-	+	Multiple land-use approach.

*W.E. Phillips, M.S. Anderson, and D.M. Toma, An Evaluation of the P.F.R.A. Community Pasture Program, 1978.

R.R. Barichello, An Economic and Distributive Evaluation of Community Pasture Programs, Department of Agricultural Economics, University of British Columbia, 1977.

DREE, ARDA, Saskatchewan Provincial Community Pastures Development: An Evaluation of a Pasture Development Program in Saskatchewan, (Regina: DREE Project Assessment and Evaluation Branch, 1977).

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Table 6.8. Incidence of Benefits and Costs of Pastures

	Government	Pastures	Others	Total
Pasture Costs:	$35,717	$693,484.44*		729,201.44
Livestock Grazing:				
Associated Costs		$1,148,424		1,148,424
Direct Benefits		$6,727,228		6,727,228
Oil and Gas Leases:				
Associated Costs			+	
Direct Benefits		+		
Hunting:				
Associated Costs		+		
Direct Benefits			+	
Scientific and Recreation:				
Associated Costs	+	+		
Direct Benefits			+	

*Costs reported in a mail survey conducted by the author.

that patrons operate on a user-pay basis, and little or no money is received from outside interests (ie. government or private companies). Oil and gas leases generate small revenues for some associations, but disrupt environments. Hunters create costs for farmers and the government through destruction of fences and vegetation. Benefits accrue to recreationists in the use of public land at the expense of livestock patrons. For the pasture program, government costs appear to be negligible ($35,717) and do not affect net benefits significantly.

Patrons of grazing associations received a net gain totalling $4,885,320 (D.B.-A.C.-P.C.). If considered in terms of meat production in 1977, an additional 15,803,249 pounds of beef (total of regions' calves X gains) was produced. On a provincial basis, the net gain per A.U.M. to a patron was $17.18, or 243.37 pounds per head.

Livestock grazing is the predominant use on this public land. Whether this use achieves maximum net benefits possible from public land is unclear. However,it appears that significant net benefits accrue from livestock uses. Various alternative uses are possible on this land either compatibly with grazing or not, and may involve tradeoffs among the uses. If an alternative use had no value, then it would not have to be considered in an analysis. However, for an alternative use to have a zero value is unlikely.

This analysis does not incorporate an opportunity cost for other foregone uses possible on this public land. A lack

of accurate and complete information prevents their inclusion. If forgone uses were included, the net benefits derived from livestock would decrease. The magnitude of the decrease in net benefits would indicate the potential of other uses, and a direction for change in current use patterns.

VII. SUMMARY AND POLICY IMPLICATIONS

A. Summary

Initially three objectives were set for this study--to describe a typical grazing association pasture patron, to delineate estimates of pasture value to a member and to society as a whole, and to detail areas of current and potential conflicts relating to the use of the pastureland.

A typical farmer using these pastures has a farm of 1,144 acres, 87 head of herd cows(120 A.U.s), and average assets of $520,521(land, buildings, machinery, and livestock). Members average 49 years of age, live 15 miles from the pastures, either are founders of the pastures or learned about it from neighbors, and have never quit using the pastures. In general, satisification is expressed regarding both the pasture operation and pricing.

Dependency on grazing association pastures for summer grazing is clearly evident from this study. Members state no other pastures are available, and average herd reductions of approximately 68% would be experienced without the pastures.

Five production functions were specified using 8 independent variables to explain beef output on patron farms. Descriptively, the high investments per A.U. required in the north region clearly illustrate the competitive advantage other regions have in production of beef. Of the

linear functions used, the best R^2 achieved was 98.43% and the lowest was 68.6% . On the basis of R^2 changes for the provincial function, cow herd numbers, assets on a farm, variable costs, and crop acres explain the most variance in output. In agreement with logic, feeding more T.D.N. and adding more herd cows would greatly increase output and farm growth. On the basis of other studies, it had been hypothesized that the use of a double-log function would be most appropriate. This proved not to be the case. This approach did not provide good evidence about the contribution of public pasture to farm size.

Estimation of pasture values to members and to society as a whole was done using a benefit-cost approach. This analysis determined that the value of an additional A.U. on summer pasture would be worth from \$125 to \$147 for a member. On the basis of a 5 month grazing season, this is \$25/A.U.M. to \$29/A.U.M. Private and association fees do not coincide mainly because associations are run on a break-even basis and range investment has been deferred.

Social benefits were measured for all four regions and in all regions but the north, net direct benefits to farmers exceeded \$1,000,000. On an A.U.M. basis, highest values occurred in the south-east region (\$19/A.U.M.), followed by the north (\$18), south-west (\$16), and east-central region (\$15).

Provincially, net direct benefits are well over \$5,000,000 at the assumed cow unit levels, using 1977 prices

and sale dates. As prices increase in the future, the benefits will rise substanially. Almost all of the pasture benefits and costs are incident upon the patrons, with virtually no government costs incurred directly. Even if other uses of the pastureland were not included in the analysis, the economic viability of the program is high. Total benefits are distributed among over 1,400 members, owning over 64,000 head. Addition of an investment multiplier in the analysis, either provincially or regionally, would further enhance the benefit stream.

Grazing, the present dominant use, may not achieve the maximum net benefits possible to derive from this public land. Alternative uses have values(benefits) in demand by other interest groups. Incorporation of these values into this analysis would decrease the magnitude of net benefits attributed to grazing. This current use pattern of public land is not irreversible or irretrivable for other uses, and, hence, the option value of the land is retained.

Currently,using a provincial accounting stance, at least four other uses on the pastures are evident--oil and gas exploration, hunting of game animals and gamebirds, scientific and educational uses, and recreation. Sufficient benefits accrue to many individuals and interests through these uses, although the costs are not as clear. In the south costs are borne by farmers when hunters damage fences or vegetation. Similarly, oil and gas companies pay out revenues to some associations, but disrupt the environment

for both livestock and wildlife. Currently, most pressure on these public lands are evident near urban centres where other uses are experiencing high public demands.

Conflicts are not a big problem, but, if mentioned, they relate back to property rights on the leases. Private leases clearly spell out duties and obligations of the involved parties, but public leases have some limitations. Range improvements are not being made by farmers on the public land, because they feel insecurity of tenure exists. Hunters also have a poor conception of their obligations to the farmer, since abuses do occur yearly. One could state that this is the case on all land, private or public, however on public land the rights of each party are unclear.

Other problems are allotment problems, predators, taxes, and conflicting uses that arise from time to time. For the province as a whole, these types of problems are not common, rather being of a local nature.

B. Policy Implications

Public lands(such as grazing association pastures) are subject to economic analysis for several important reasons. Questions of how resources are allocated in a society, and who pays the costs of these uses in society can be answered by such analysis. Public land has to be allocated for use among members of society or different interacting uses in order to satisfy various needs and demands over time.

Economic analysis serves an important role since

questions of best resource use over time can be answered. Basically, this involves discounting the future stream of benefits and costs back to the present in order to ascertain the best-use pattern between uses or within uses over time. By doing so, comparative values of different uses or use combinations can be made and used in decision-making. This helps to indicate which use to follow in order to achieve a social maximization of welfare.

Allocation questions are dealt with readily, but because of market imperfections, problems of incidence arise. Incidence, or who bears the benefits and costs of the resource use, is the second part of the problem. Incidence is used to identify how the costs are distributed in society.

Public policy tries to address these questions of allocation and incidence in terms of efficiency and equity criteria. Depending on the focus of a particular policy, usually one of these criteria is followed.

In Alberta, initial program objectives on the use of public land seemed to address the efficiency criteria more. Policy was established to curb abuses on public land, help smaller operators expand and diversify their farms, and to encourage efficiency in the industry.

Results indicate two objectives have been met--stopping abuses and promoting growth--however a policy deficiency appears to exist. Public Land Act regulations restrict abuses on the land, but no incentives exist to encourage

improvements or better land management. Two major methods to achieve better management are penalties for abuses, and rewards for correct management.

Operators having access to grazing association pastures have benefitted to a large extent. Benefits occur through expansion, secure pasture supplies, and secure costs. How much growth in the farm-firm is actually due to membership and use of association pastures is unclear. However, growth on patron farms has occurred through this program.

Pasture development in the future is anticipated and a standard criteria should be applied in planning.[64] If efficiency(least-cost) criteria are used, then the emphasis on incentives and land development would have to be concentrated in the south of the province. Fewer inputs are required to produce beef in this region. If equity(pasture for all) criteria are used as a basis, then it would be necessary to develop pasture supplies in all regions, regardless of advantage or cost differences. On the evidence of allotments per member, head per pasture, and membership sizes, it could be argued more pastures are needed in the north. Further research in this area regarding costs and need is required prior to pasture implementation.

Indications are that, provincially and regionally, pasture benefits greatly exceed costs. The program is economically viable and self-sufficient, and benefits accrue

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[64]Similar recommendations were reached by R.J. Miller in _An Economic Guide to Range and Pasture Improvement in Alberta_ (Alberta Energy and Natural Resources, 1971).

to over 1,400 patrons at present. If consideration of alternative uses (allocation among uses) were given in lieu of grazing, then the net benefits from grazing would decline. Important aspects to note are the independance valued by the patrons and the resource management that is currently in place. Without it , wildlife habitats could suffer, for example, because of the possibility of ungrazed grass and fire risk. Irreversibilities are avoided through grazing and a choice of future use patterns is maintained.

An area of concern for the future and an indication of a present weakness in the policy is property rights definition. It is clearly evident that range improvements are not undertaken because of insecure tenure. Problems encountered yearly with hunters result,partly at least, from a lack of explicit recognition of concerned parties' obligations. In the future, pasture planning should account for oil and gas lease disruptions that may occur. Research in the area of public land use and tradeoffs among uses is required.

In the future, as populations increase and land supplies become more valuable, so too will public pasturelands become more precious to people in society. Policy-makers of that time will find various interests vying for use of this resource and will need answers. By addressing some of the previously mentioned concerns and by trying to ensure uses are able to occur commensurately with each other, future conflicts may be avoided, or at least,

minimized.

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APPENDIX A: QUESTIONNAIRE

STRICTLY CONFIDENTIAL

Survey Questionnaire

A. Personal Data NO.______

1.Age ______

2.Highest education level gained: up to grade 9____ up to grade 12____ vocational___ university____

3.Born in Canada?yes__ no__

4.Born in Alberta?yes__ no__

5.Born and raised on a farm?yes__ no__

6.Number of years farming______ Number of years at this location______

7.Number of years raising beef____ Number of years finishing beef________

8.Ever work off-farm?yes__ no__ part-time__ full-time__

9.What time of year?______

10.Have you ever joined?

	yes(yrs.)	no	currently a member
4-H			
Unifarm			
NFU			
CAM			
Others			

11.What was the first year you started to use the community pasture?______

12.How did you first learn of it?______

13.Number of years using it______

14.Ever quit using it?yes__ no__ Why?______

15.Is the pricing of it fair?______

16.Any problems with it now?______

17.If more land was available would you use it?yes__ no__

18.Could you pasture your cattle on other lands if there was no community pasture ?yes__ no__ own lands___ neighbors___ other__

19.Would you have to decrease your herd size without it?yes__ no__ How much?(%)

______

20.What enterprises do you operate? cow-calf__ feeders__ grain__ hogs__
poultry__ sheep___ others____

21.Which is the major income earner?(over a 5-yr. period)________________

22.What breed of cattle do you have? pure___ cross-breds___ Herefords__ Angus___
Shorthorn___ Charlais____ Simmental___ others____________________________

23.If you buy cattle where do you buy most of them? Country auction___ neighbors___
breeder____ hire an agent___ others______________________________________

24.What other inputs would you require without the community pasture? more feed___
more rented pasture(neighbors etc.)___ use own land for pasture___ cut down herd___

25.How is your farm income broken down(%)?

product			amount last year	amount last 5 yrs.
cow-calf				
feeders				
grain				
hogs				
poultry				
horses				
pure bred cattle				
others				

26.What is all of your farm and assets worth?(what would you pay?)

asset	size		present value
land			
buildings			
machinery			
livestock			
others			

27.Was any of your land inherited?yes__ no__ What amts. and value if yes?____________
____

B. Farm Data

1. Distance from the community pasture(miles)________________________________

2. Maximum distance you would go to a community pasture(miles)________________

3. Could the community pasture support more cattle now? yes__ no__, if yes how many?

____

4. If there was more water could it support more cattle? yes__ no__

5. If the pasture condition was improved would it support more cattle? yes__ no__

If yes, what kind of improvements?____

____

6. What amount of money is spent directly by you to support the pasture?________

____

7. What amount of money is spent indirectly by you to support the pasture?______

____

8. How many cows normally graze on community pasture (your own)?________________

____

9. How many cows normally graze on your own pasture?____________________________

____

10. What is the going rental rate for private pasture in this area?____________

____

11. What is your reason (2 main) to use the pasture?____________________________

____

____

12. Size of your farm(owned land)?____

13. How much is your land worth?

	Original Price	Acres	Present Value(estimated)
Original land			
Other purchases			
Total:			

14. Did you rent land last year? yes__ no__ cultivated___ pasture____ other_____

15. If yes, why did you rent land last year?____________________________________

____

16. If you rented land out, what was the rental?

	Per acre rent	Total cash rent	Crop share
1976 cultivated			
1977 cultivated			
pasture			

16. If you rented, what was the rental rate?

	Per acre rent	Total cash rent	Crop share
1976 cultivated			
pasture			
1977 cultivated			
pasture			
1978 cultivated			
pasture			

17. Acreage use (1977 breakdown)

	Owned	Cattle on	Soil class	Rented	Cattle on	Soil class	use normally
Cultivated							
Summer Fallow							
Forage or hay							
Pasture (native)							
Pasture (improved)							
Farmstead, fences, bush, roads/Total:							

18. Do you rotate tame hay with crops? yes__ no__, if yes, what is the pattern of rotation?______

19. At what age are hayfields reseeded if done?______
lbs./acre, mixture______

20. Is fertilizer used on any of the following crops?

crop (variety)	date applied	fert. analysis	fert. lbs./acre	seed lbs./acre	bushels, tons, bales normal yield	bushels, tons, bales last yr. yield	Acres Crop	Total Cost per Acre
wheat								
oats								
barley								
other								
tame hay								
tame pasture								
forage seed								
native hay								
native pasture								

Haying Operations

1. What combination of the following do you use to make hay?

mower	forage harvester
mower-conditioner	bale wagon
swather	loose pickup
windower	stooker
baler-round	stackmover
baler-square	tractor- with-fork--bales
truck (kind)__________	--loose hay
others ________________	rake

2. Are your bales round__ or square__?
3. What is the usual weight of a bale you make?________________________
4. What is the usual no. made per acre (bales)?________________________
5. What is the usual tonnage of hay produced per acre? ________________
6. What is the usual amount produced in a year? ______________________
7. Is any of your hay custom-made? yes__ no__ , if yes what is the cost per bale?
____
8. What is the usual amount of hay you buy each year? ____________________
9. Which of the following systems do you use in making hay? ______________
(see accompaning pictures for systems)

Winter Feeding Program

1. Has your cowherd increased, decreased, or been the same in nos. over the last 2 years? ____
2. What are your plans for the next 2 years? ______________________________
____
3. What is the main reason for these plans? ______________________________
____
4. When do you start winter feeding and end it for your cowherd? __________
____
5. When do you start winter feeding and end it for your feeder cattle? ________
____
6. When are feeders sold and at what ages, weights? ______________________
____
7. When does herd culling take place? ___________________________________
____
8. What happens to unbred cows? ____
____

9. On what basis do you select the culls? ______________________

____

10. If unbred cows are sold, when and at what weights, ages? ______________________

____

11. At what ages are cows replaced? ______________________

____

12. How many replacement heifers are kept each year? ______________________

____

13. What ages, weights are these heifers? ______________________

____

14. If A.I. is used, do you do it yourself or hire a technition? ______________________

____

15. At what dates are most of your calves born? ______________________

____

16. What do you estimate your calving survival rate at(%)? ______________________

17. When are bulls culled and at what ages, weights? ______________________

____

18. Are the bulls sold for breeding__ or slaughter__ ?

19. At what age do you replace your herd bulls? ______________________

20. Are new bulls(herd) purchased through a: neighbor__ breeder__ auction sale__ ads in papers, magazines__ others__ ?

21. Are the bulls bought: locally__ northern Alberta__ central Alberta__ southern Alberta__ Canada__ U.S.A.___ others___?______________________

22. When cows and bulls come off the community pasture, do they go to: feedlot__ graze other pasture__ graze stubble__ others__? How long(days)?______________________

23. When calves, heifers, steers come off the community pasture, do they go to: feedlot__ graze other pasture__ graze stubble__ others__? How long?______________________

24. How is watering of your cattle done?

	well (depth)	dugout (size)	others (sloughs, creeks)
Home: summer			
winter			
Pasture: summer			
winter			

C. Labor For Beef Production

Operation	no. of hired	no. of family	operator labor	Periods worked	days worked	hrs. per day	per hr. cost	Total	
								hrs.	cost
Haying									
Baling Straw									
Baling Bedding									
Repairs(fences,									
corrals,other									
cow equipment)									
Salting,checking,									
inspection									
Branding,dehorning									
vaccinate,castrate									
Transporting,									
moving cows									
Selling,buying									
Manure removal									
Winter feeding									
Calving									
Crushing, rolling									
Total:									

D. Cattle Numbers(1977)#1

Class	no. at Dec. 1976	Purchase 1977	loss or death	Births	Sales	Total Dec. 1977	Ave. wt. to C.P.	Ave. wt. off C.P.
Calves								
1yr. Heifers								
2yr. Heifers								
Mature cows 3yr., older								
Total:								
1yr. Heifers (non-breeding)								
1yr. Steers								
2yr. Steers								
Bulls(breeding)								
Bulls(non-brd)								
Total:								

Cattle Numbers #2

SALES

Class	no.	age	total weight	total receipts	date			
Feeders								
Calves(bulls)								
Calves(heifers)								
1yr. Steers								
1yr. Heifers								
Breeding Cows								
Slaughter Cows								
Breeding Heifers								
2yr. Steers								
2yr. Heifers								
Bulls(breeding)								
Bulls(non-brd) (slaughter)								
Fat Cattle								

Cattle Numbers #3

PURCHASES

Class	no.	age	date	total weight	total receipts				
Feeders									
Calves(bulls)									
Calves(heifers)									
1yr. Steers									
1yr. Heifers									
Breeding Cows									
Slaughter Cows									
Breeding Heifers									
2yr. Steers									
2yr. Heifers									
Bulls(breeding)									
Bulls(slaughter)									
Fat Cattle									

E. Variable Costs

Item	per month	per annum	beef portion					
Office supplies								
Accounting, bookeeping								
utilities (power, gas)								
Fuel (gas, oil)								
Repairs (equip)								
Insurance (bldg, machines, livstk crop)								
A.I., bull fees								
telephone								
vet. supplies, fees								
Interest on cow loans								
Interest on equip or land payments								
Haying costs twine, reseeding								
Custom work								
Trucking, insur., commision fees								
Taxes (land, bldg)								

F. Feed Costs-Quantities

Types Fed	Cows, 2yr. Heifers	1yr. Heifers	Yearlings Bulls Calves	Total own prod	Amount bought	Price per unit	unit Grades	
Time fed from-to								
Legumes								
Tame grass								
Native grass								
Greenfeed								
Straw								
Other								
Time fed from-to								
Wheat								
Oats								
Barley								
Other								
Time fed from-to								
Salt								
Minerals								
Supplements								
Other								
Bedding Ave. wt. fall Ave. wt. spring Daily gain								

G. Machinery and Buildings (fixed assets)

Item	size	no.	age or yr. aqud.	life	orig cost	pres. value		
Land (feedlot, pst)								
Buildings (non-owners living ac)								
Buildings (tools, machine, storage)								
Building (shelters sheds, barns)								
Fences, corrals								
Pens, chutes								
Granaries								
Silos, hay sheds								
Water (pumps, pipes troughs, heaters, waterers, dugout)								
Feed bunkers, troughs, mangers								
Horses								
Tack (saddle, etc)								
Spray eguip. (for livstk)								
Calf puller								
Medical eguip. (for livstk)								

G. Machinery #2

Item	size	no.	age or yr. aqud.	life	orig. cost	pres. value		
Feedlot equip. hammermills, scale augers								
Port. equip. feed wagons, manure spreaders, augers trailers								
Other equip.								
Tractors								
Trucks								
Hay equip.								

APPENDIX B: CORRELATION MATRICES

Correlation Coefficients

Province Data

	Y	X1	X2	X3	X4	X5	X6	X7	X8
Y	1	.88	.79	.76	.08	.65	.26	.59	.46
X1		1	.62	.63	-.07	.64	.43	.58	.44
X2			1	.70	.43	.44	-.02	.49	.26
X3				1	.27	.56	.19	.32	.47
X4					1	-.05	-.17	.18	.19
X5						1	.25	.18	.19
X6							1	.40	.38
X7								1	.53
X8									1

North Data

	Y	X1	X2	X3	X4	X5	X6	X7	X8
Y	1	.01	.33	.20	.34	-.004	-.04	.65	.20
X1		1	.01	-.48	.01	-.049	.04	.10	.64
X2			1	.50	.77	-.22	.21	.28	-.18
X3				1	.31	-.44	.58	-.025	-.19
X4					1	-.22	.043	.15	.02
X5						1	-.58	-.005	.13
X6							1	-.38	.103
X7								1	.121
X8									1

Correlation Coefficients

East-central Data

	Y	X1	X2	X3	X4	X5	X6	X7	X8
Y	1	.88	.73	.64	.65	.15	.39	.81	.71
X1		1	.66	.64	.56	.33	.54	.87	.71
X2			1	.63	.61	.25	.26	.59	.38
X3				1	.60	.53	.25	.61	.68
X4					1	.47	-.05	.43	.36
X5						1	-.09	.19	.05
X6							1	.63	.52
X7								1	.69
X8									1

South-east Data

	Y	X1	X2	X3	X4	X5	X6	X7	X8
Y	1	.96	.77	.76	-.23	.93	.46	.42	.88
X1		1	.77	.82	-.17	.89	.56	.41	.83
X2			1	.84	.11	.79	.46	.47	.47
X3				1	.01	.71	.43	.24	.46
X4					1	-.05	.05	.09	-.47
X5						1	.41	.48	.77
X6							1	.49	.40
X7								1	.29
X8									1

Correlation Coefficients

South-west Data

	Y	X1	X2	X3	X4	X5	X6	X7	X8
Y	1	.93	.83	.80	-.04	.94	.26	.61	.49
X1		1	.68	.68	-.20	.89	.35	.53	.25
X2			1	.72	.36	.83	-.19	.56	.43
X3				1	.23	.82	.19	.29	.71
X4					1	.00	-.29	.11	.29
X5						1	.12	.40	.42
X6							1	.22	.29
X7								1	.32
X8									1

Y, pounds of beef produced in a year

X1,number of beef cows

X2,total farm assets($)

X3,variable costs($)

X4,crop acres

X5,deeded pasture acres

X6,association pasture acres

X7,T.D.N. fed(tons)

X8,labor(hours)

DATE DUE
